

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Dubois County, Indiana

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COUNTY SURVEYED

Dubois County is in southwestern Indiana (fig. 1). Jasper, the county seat, is 135 miles southwest of Indianapolis and 60 miles northeast of Evansville. The total area of the county is 427 square miles, or 273,280 acres.

Dubois County covers parts of two physiographic divisions which dominate southwestern Indiana—the Crawford upland and the Wabash lowland.¹ The Crawford upland covers the eastern part of the county. It is the remnant of a peneplain where stream dissection has reached a mature or postmature stage, and little or none of the original peneplain remains. The average elevation of the deeply notched divides is approximately 700 feet above sea level. This division is characterized by considerable diversity of relief, and it includes high hills, low hills, steep slopes, moderate slopes, ridges that do not maintain an even altitude, and flat-bottomed valleys with wall-like bluffs. Benches, formed by rock strata that are resistant to weathering, occur in many places between the valley floors and the ridge tops, and stream dissection is both complete and thorough. This is especially true in the northern and southern parts, where local differences in elevation in many places exceed 200 feet. Throughout this division the ridges are narrow, sharp, and have very steep slopes, although in the vicinity of Schnellville, as the main streams lie at some distance, the grade level of the local drainageways is at a higher altitude, the ridges are wider and more rounded, and the slopes are more moderate.

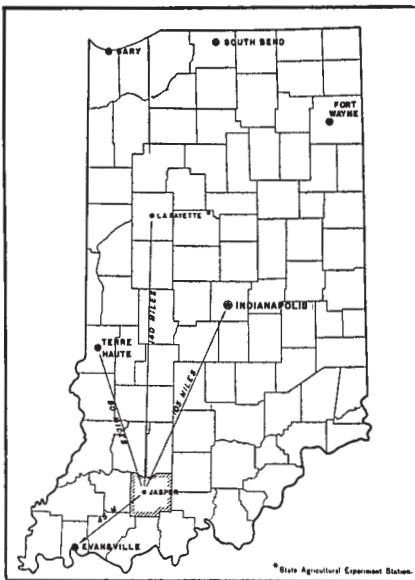


FIGURE 1.—Sketch map showing location of Dubois County, Ind.

¹ LOGAN, W. N., CUMINGS, E. R., MALOTT, C. A., VISHNER, S. S., TUCKER, W. M., and REEVE, J. R. HANDBOOK OF INDIANA GEOLOGY. Ind. Dept. Conserv. Pub. 21, 1,120 pp., illus. 1922.

As the western limits of the Crawford upland are approached, the average elevation of the ridges gradually decreases from 700 to about 500 feet which is the level of the Wabash lowland. The northern part of this lowland is approximately 30 feet lower than the southern part. The Wabash lowland is characterized by shallow aggraded valleys with unusually wide bottoms. The valley of Patoka River, the only stream crossing the county, is an example of this difference between the Crawford upland and the Wabash lowland. Where the river traverses the Crawford upland, its valley is approximately 250 feet deep and less than one-half mile wide; but below Dubois, where the river enters the Wabash lowland, the valley is only about 50 feet deep, and within a short distance the strip of alluvium is a mile wide. South of Ireland it is 2 miles wide, and just above the point where the river leaves the county, the bottom again becomes very narrow. This narrow bottom is a new channel which the river was forced to cut when the Illinoian ice sheet blocked the original valley.

Blocking of streams by the Illinoian ice sheet resulted in the development of two types of relief in the Wabash lowland. Prior to the intrusion of the glacier the drainage waters flowed northwestward, but when these were obstructed a lake was formed in the northern part of the county, which became filled with silt and other sediments from the streams and the melting glacier, forming a plain. The plain is comparatively smooth, with precipitous drops to the rather shallow valleys. One of the peculiarities of this section is the occurrence of isolated remnants of the former uplands, which are underlain by bedrock at a comparatively slight depth. These "island hills", as they are called, occur as rounded knolls rising about 30 feet above the surrounding plain. Areas of such character occur $1\frac{1}{2}$ miles southeast of Lemmon School in sec. 36, T. 1 N., R. 6 W., and $2\frac{1}{2}$ miles northwest of Ireland in sec. 11, T. 1 S., R. 6 W.

The rest of the Wabash lowland within this county is more completely dissected, and the slopes are more gradual than on the flatter land to the north. The ridges are broader and more rounded, in many places sloping gently to the stream valleys which are about 50 feet deep. The central and southwestern parts of the county are completely dissected but, because the grade level of the streams is lower and erosion has been in progress a long time, the slopes are less steep than those in the eastern part. The aggradation of streams, so characteristic of the Wabash lowland, is well illustrated here.

Dubois County, with the exception of some of the Patoka River bottoms and the flatter places in the smoother country in the northwestern part, is well drained. Some of the land, particularly in the vicinities of Cuzco and Birdseye, is excessively drained. Patoka River drains the greater part, but the northern part drains into East Fork White River, and the extreme southeastern part drains directly into the Ohio which eventually receives all the drainage waters of the county.

Elevations ² of railroad stations at some of the towns in the county are as follows: Ferdinand 525 feet, Jasper 467 feet, Birdseye 711 feet,

² GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U. S. Geol. Survey Bull. 274, ed. 4, 1,072 pp. 1906.

Mentor 717 feet, St. Anthony 487 feet, Bretzville 529 feet, Huntingburg 462 feet, Duff 467 feet, and Kyana 503 feet.

The first white settlement in the section now included in Dubois County was made by William McDonald in 1801. The county was formed in 1817 by cutting off the eastern end of Pike County. In 1818, 18 sections from the southeastern corner were annexed to Perry County; and the present boundaries were established in 1820 when part of the northeastern corner was annexed to Martin County.³ The early settlers came from the southeastern States and were of English extraction, and in 1825 German immigrants came in large numbers. The 1930 census reports the population of the county as 20,553, of which 7,345 are urban and 13,208 rural. The principal towns are Jasper, with a population of 3,905, and Huntingburg, with 3,440. Ferdinand, Birdseye, Holland, and Ireland are the more important smaller towns. Jasper has many furniture factories, in which a large quantity of office furniture is manufactured. Huntingburg is a railroad center.

The Southern Railroad provides good transportation facilities, as the main line from Louisville to St. Louis passes through Huntingburg, with a branch extending south to Evansville and another extending northeast to West Baden, where connection is made with the Chicago, Indianapolis & Louisville Railway (Monon route) for Indianapolis. The Ferdinand Railroad extends from Ferdinand to Huntingburg.

A large proportion of the farm products is consumed locally. Some livestock is shipped to Indianapolis and Evansville. Much of that going to Evansville is transported by trucks. Wheat is sold through a pool, the elevator being at Huntingburg.

The main highways are kept in fair condition, and two State roads which cross the county are well maintained. All the smaller towns, with the exception of Celestine, are connected by gravel roads. The secondary roads are poor, and when wet are frequently impassable.

CLIMATE

Dubois County has a continental climate characterized by moderate winters and hot, dry summers. Some winters have short periods of subzero weather. The rainfall in general is well distributed throughout the year. Severe droughts are rare, as the rainfall is usually sufficient for the use of growing crops.

The average date of the latest killing frost is April 23 and of the earliest is October 15, giving an average frost-free season of 175 days. Frosts have been recorded as late as May 28 and as early as September 27.

Table 1 gives the more important climatic data, as recorded at the United States Weather Bureau station at Huntingburg, in the southern part of the county. These data are considered representative for the county as a whole.

³ WILSON, G. R. WILSON'S HISTORY OF DUBOIS COUNTY. 411 pp., illus. Jasper, Ind. 1910.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Huntingburg, Dubois County, Ind.*

[Elevation, 462 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1913)
	°F.	°F.	°F.	Inches	Inches	Inches
December.....	36.3	71	-8	4.06	1.95	4.71
January.....	34.4	71	-1	4.45	6.82	11.99
February.....	36.8	73	-12	4.04	3.15	1.78
Winter.....	35.8	73	-12	12.55	11.92	18.48
March.....	45.5	88	0	4.26	2.15	11.56
April.....	55.7	90	20	4.73	.70	3.41
May.....	64.6	100	24	4.71	2.03	1.63
Spring.....	55.3	100	0	13.70	4.88	16.60
June.....	73.4	102	38	4.42	3.87	5.61
July.....	77.3	106	42	4.01	1.06	1.92
August.....	76.1	105	39	4.02	1.66	2.35
Summer.....	75.6	106	38	12.45	6.59	9.88
September.....	70.8	101	30	3.98	5.47	7.27
October.....	57.5	95	21	3.49	1.94	5.31
November.....	46.1	80	8	3.69	1.75	8.12
Fall.....	58.1	101	8	11.16	9.15	20.70
Year.....	56.2	106	-12	49.86	32.55	65.66

AGRICULTURE

A general type of agriculture has always been practiced in that section of the State in which Dubois County lies. The early settlers were practically self-supporting, and the farmers still produce much of their food and feed. Many small mills scattered over the county grind flour and meal for local use.

According to the 1935 Federal census report, 94.5 percent of the land area of the county is included in 2,209 farms, with an average size of 116.9 acres. Of the land in farms, 127,370 acres are classed as crop land, 27,895 acres as plowable pasture, 41,091 acres as woodland and other pasture, and 61,778 acres as woodland not pastured and other land in farms, the latter including land occupied by buildings, roads, and waste land. Most of the farms range in size from 50 to 175 acres, with a few including less than 50 acres and a few more than 175 acres.

Of the 2,209 farms, 1,806 were operated by owners and part owners in 1935; 397 by tenants; and 6 by managers. The work on most farms is done by the farmer and his family. When extra help is needed, it is obtained locally.

The average value of land and buildings a farm in 1935 was \$3,279, or \$28.06 an acre.

The principal crops grown in 1934, in order of the acreage occupied, were corn, wheat, hay, and oats. Corn was grown on 32,950

acres, wheat on 27,119 acres, and oats on 10,186 acres. Most of the corn was harvested for grain. Hay of all kinds and sorghums for forage were cut from 26,869 acres in 1934. Timothy and clover, either alone or mixed, are the principal hay crops.

Most of the corn, oats, and hay are used on the farm where produced, but much of the wheat is sold through a cooperative elevator in Huntingburg, or to local mills to be ground into flour. The less important farm crops are potatoes, sorgo for sirup, both of which are subsistence crops, and tobacco and vegetables as cash crops. Potatoes were grown on 604 acres in 1934, tobacco on 81 acres, and sweetpotatoes on 153 acres. Some vegetables, especially tomatoes, are grown for sale, and, in the vicinity of Dubois, tomatoes are grown for canneries located in an adjoining county. Farm garden vegetables of many varieties are grown for home use only.

The raising of livestock is an important source of revenue. Hogs, cattle, and some sheep are shipped to Indianapolis and Evansville. The production of eggs is an important source of income to many farmers.

Table 2 gives the value of all farm products by classes in 1929 as reported by the 1930 census.

TABLE 2.—*Value of agricultural products, by classes, in Dubois County, Ind., in 1929*

Crop	Value	Livestock and livestock products	Value
Cereals.....	\$972, 182	Domestic animals.....	\$1, 406, 958
Other grains and seeds.....	118, 170	Dairy products.....	320, 199
Hay and forage.....	373, 404	Poultry and eggs.....	672, 544
Vegetables (including potatoes and sweetpotatoes).....	95, 052	Wool.....	3, 170
Fruits and nuts.....	29, 433	Honey.....	652
All other field crops.....	28, 589	Total.....	2, 403, 323
Forest products.....	123, 811	Total agricultural products.....	4, 203, 808
Farm garden vegetables.....	59, 784		
Total.....	1, 800, 485		

The 1930 census reported that in 1929 there were 27,576 apple trees of bearing age, 17,798 peach trees, 1,899 pear trees, 1,323 plum trees, 1,027 cherry trees, 14,987 grapevines, 12 acres in strawberries, 10 acres in blackberries, and 2 acres in raspberries. The same census reported 4,546 horses, 1,923 mules, 12,334 cattle, 23,703 swine, 3,685 sheep, 200,696 chickens, and 557 hives of bees in the county on April 1. The census for 1935 reported 4,321 horses, 1,977 mules, 15,341 cattle, 2,813 sheep, and 28,611 swine on the farms on January 1 of that year.

There were in 1930, 1,539 automobiles on the farms, 126 motor trucks, 270 tractors, 18 electric motors for farm work, and 91 stationary gas engines. Telephones were in 1,390 farm homes, 156 farmers had water piped to the dwelling house, and 111 farmhouses were lighted by electricity. In 1929, farm expenditures included \$249,354 for feed on 1,449 farms; \$163,061 for fertilizer (including commercial fertilizer, manure, marl, lime, and ground limestone) on 1,598 farms; \$131,589 for labor on 730 farms; \$132,109 for implements and machinery (including automobiles) on 529 farms; and \$2,770 paid to power companies for electric power on 45 farms.

Average crop yields are small, and land is cheap, although both of these features differ widely. The highest yields are obtained and the most valuable land is in the western part of the county, and the lowest yields and cheapest farms are in the hilly sections.

Erosion is a serious problem, especially in the hilly sections, and many poorly managed fields have been abandoned and have grown up to brush.

SOILS AND CROPS

Agriculturally, Dubois County may be divided into two sections. The more important one is in the northwestern part. This section, on account of its productiveness, is locally known as the "bread basket." About 95 percent of the land in this section is cultivated, and the rest, occurring on steep valley walls or in poorly drained areas, is left in timber or used as pasture. The rest of the county (about three-fourths of the total area) includes large bodies of timberland and permanent pastures, and here only the tops of the ridges, the smoother slopes, and the wider stream bottoms that are sufficiently well drained, are cultivated. About one-half of the land in this section is steep, and the soil erodes very readily where improperly used.

All the county was originally covered with a deciduous forest, in which oaks were the predominant species. As a result, all the soils, with a few minor exceptions, are light colored and contain only a small quantity of organic matter. Even though a few of the soils contain free lime at a comparatively slight depth, all the upland soils are acid; but some of the soils on the alluvial flood plain of East Fork White River are neutral or alkaline in reaction.

Apparently, the most productive upland soil of the agricultural section is Bainbridge silt loam which, although not the most extensive soil in this section, has a dominating influence on the agriculture. This soil, together with the Haubstadt, Dubois, and Robinson silt loams, which occur in the same locality, makes up about 80 percent of the so-called "agricultural region." All these soils are extremely silty in their surface layers. Several soils of smaller extent occur along the northern limits of the upland and in the East Fork White River bottoms, and these, although locally important, do not have much influence on the general agricultural practices.

Not all the land outside this northwestern section is nonagricultural, as considerable land is farmed in places where the hillsides are not too steep and the ridges too narrow. The part of the county outside the northwestern agricultural section is a "two-soil" section. The agricultural soil is Zanesville silt loam which occurs on the crests of the ridges and on the more gentle slopes. The steeper hillsides are mapped as Muskingum soil. This latter soil, which is dominant in the northeastern and southeastern corners of the county, is largely nonagricultural, and most of it is used for pasture or for growing timber.

Where large individual areas of Zanesville silt loam occur, as near Holland, Ferdinand, and Schnellville, agriculture is well developed and is of the same general type as that practiced in the northwestern part. Some sorghum cane (sorgo) is grown in this section, principally west of Schnellville. Wheat and oats are grown

on a larger proportion of the cultivated land here than in the north-western part where the soils are better adapted to growing corn. The soils in the stream bottoms are adapted to corn, and a large acreage is devoted to this crop. Tobacco is a rather important crop in the vicinity of Ferdinand, and a fairly large acreage is planted each year.

Considered on the basis of soil characteristics as related to agriculture, the soils of the county may be grouped as follows: (1) Well-drained soils of the uplands and terraces, which are moderately productive general farming soils, except where too steep or too stony; (2) light-colored poorly drained soils of the uplands and terraces, which are generally low in fertility and in most seasons too wet for maximum crop yields; (3) dark-colored poorly drained soils which are excellent soils, especially for corn, when drained, but are small in total area; (4) soils developed from alluvium, which occur on the first bottoms, or overflow land of the streams, and which vary widely in use and productivity, but are all too wet or subject to too frequent overflows to be used for general farming, and (5) muck which consists of organic material in the surface layers.

In the following pages, the soils of Dubois County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Dubois County, Ind.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Bainbridge silt loam.....	6,912	2.5	Harbison silt loam.....	128	0.1
Bainbridge silt loam, slope phase.....	4,352	1.6	Montgomery silty clay loam.....	128	.1
Zanesville silt loam.....	80,896	29.6	Genesee silt loam.....	832	.3
Zanesville silt loam, slope phase.....	55,872	20.4	Genesee fine sandy loam.....	384	.1
Zanesville silt loam, eroded phase.....	2,304	.8	Genesee loam.....	256	.1
Pike silt loam.....	128	.1	Tyler silty clay loam.....	320	.1
Muskingum stony silt loam.....	16,320	6.0	Tyler silty clay loam, brown phase.....	1,536	.6
Haubstadt silt loam.....	12,416	4.5	Eel silty clay loam.....	384	.1
Alford silt loam.....	1,856	.7	Eel silty clay loam, meander phase.....	320	.1
Princeton fine sandy loam.....	704	.2	Holly silt loam.....	41,408	15.2
Princeton silt loam.....	64	.1	Holly silt loam, dark-colored phase.....	576	.2
Elk very fine sandy loam.....	320	.1	Stendal silty clay loam.....	2,304	.8
Tilist silt loam.....	9,088	3.3	Pope loam.....	13,440	4.9
Robinson silt loam.....	4,928	1.8	Waverly silt loam.....	5,120	1.9
Johnsburg silt loam.....	1,152	.4	Waverly silty clay loam.....	1,536	.6
Iva silt loam.....	192	.1	Muck.....	64	.1
Iva silt loam, sandy phase.....	(1)	(2)			
Dubois silt loam.....	6,656	2.4			
McGary silt loam.....	384	.1	Total.....	273,280	-----

¹ Approximately 25 acres.

² Less than 0.05 percent.

WELL-DRAINED SOILS OF THE UPLANDS AND TERRACES

Soils included in this group are the best general farming soils in the county. They are all light colored. The local relief is sufficient to remove surface water, and underdrainage ranges from good to excessive.

Bainbridge silt loam.—Bainbridge silt loam, said to be the most productive upland soil in the agricultural section, has many very desirable characteristics.

In cultivated fields, the surface soil is yellow or yellowish-brown silt loam, in which the silt content is high. This material, at plow depth, becomes lighter colored but still retains a distinctly yellowish cast and silty texture. At a depth of about 11 inches, the soil material becomes gradually brighter in color and heavier in texture until, at a depth of about 15 inches, it is silty clay loam and in many places is brownish-yellow or reddish-yellow silt loam or silty clay loam. This continues to a depth ranging from 3 to 4 feet where rather bright brownish-red sandy material is reached. This layer is thick, in many places ranging from 4 to 5 feet in thickness, and is the distinguishing feature of the soil. It is an important feature, as its sandy character allows easy movement of water and gives good drainage even on nearly level land.

This soil is well drained and oxidized throughout. The oxidation, as indicated by the reddish-yellow color of the subsoil layers, shows that it is well aerated and never waterlogged. Although the content of silt is high, sufficient clay is present in the surface soil to produce a texture and structure favorable to good tilth and excellent moisture-holding capacity. The subsoil is slightly heavier than the surface soil, but it contains no hardpan or claypan, and plant roots penetrate easily and deeply. Therefore crops on this soil can withstand prolonged dry periods. The open character of the surface soil and subsoil also allows easy penetration of water, so that surface run-off is slight, and, except near drainageways, there is little surface erosion and no gullying. The silty texture renders the soil retentive of moisture and prevents baking.

The light color indicates that the organic-matter content is low, and barnyard manure and green-manure crops are beneficial. The soil is acid, and, especially when growing alfalfa, lime must be added. Corn and small grains grow well without lime, and fair stands of red clover can be obtained where no lime has been added. Another desirable feature of Bainbridge silt loam is its level or gently undulating relief which facilitates tillage.

Although good crops of corn, ranging from 40 to 50 bushels an acre, are produced, the soil is better suited to wheat, other small grains, and hay, as optimum conditions for the production of corn require more organic matter and more moisture than is available. Wheat usually yields from 15 to 25 bushels an acre and hay about 1 ton.

Bainbridge silt loam, slope phase.—Bainbridge silt loam, slope phase, occurs on the steep breaks from the upland to the stream beds. It is similar to typical Bainbridge silt loam in soil characteristics, but the various layers are thinner, and the brownish-red sandy material is nearer the surface. Its position on slopes has little agricultural significance other than that it interferes somewhat with cultivation and increases the susceptibility to erosion. The land may be droughty in long dry periods.

Zanesville silt loam.—Zanesville silt loam, commonly called "red clay land", is the principal agricultural soil of the eastern half and the southwestern quarter of the county. It is similar to Bainbridge silt loam in the upper part, in color, texture, and structure characteristics. Where cultivated, the topmost 6-inch layer is light yellowish-brown silt loam which grades into reddish-brown silty clay loam that

extends to a depth of 10 inches. The upper part of the subsoil, to a depth of about 20 inches, is brownish-red or yellowish-red silty clay loam. Below this, heavy silty material extends to a depth of several feet, through partly weathered sandstone or shale to bedrock which lies at a depth ranging from 6 to 8 feet.

Zanesville silt loam is characterized by a rolling relief and is subject to loss of moisture by rapid run-off and to severe surface wash where poorly managed. During a long dry period crops suffer on this soil.

Zanesville silt loam has about the same crop adaptations as Bainbridge silt loam, but it returns slightly lower yields. It is used extensively for small grains, because, wherever possible, the farmers plant corn on the bottom lands. The most fertile areas will produce good crops of corn, however, in favorable seasons, probably 40 bushels an acre. Another disadvantage of this soil is that, owing to its location on the ridges and gentle slopes, it is in many places very difficult to cultivate, as the fields are small and irregular and may lie at some distance from the farmstead.

This soil is very acid, and the effect of lime is plainly seen in clover fields along the graveled roads in sections where the soil is predominant. Close to the roads where the limestone dust has settled on the fields, the stand of clover is thick and vigorous, but a few rods farther away it is thinner and the plants less vigorous.

Zanesville silt loam, slope phase.—This soil occurs in close association with Zanesville silt loam, but, as it occupies steeper slopes, it is usually left in timber or used as pasture. It is cultivated only when it can be used to improve the shape of a field. This soil has characteristics comparable to those of typical Zanesville silt loam, but the various layers are thinner and the depth to bedrock varies. The rock even outcrops in some places. The 5-inch surface layer is grayish-brown silt loam where not cultivated, but under cultivation the brown color soon disappears, leaving a grayish-yellow surface layer. The subsurface soil, which continues to a depth of about 8 inches, is brownish-yellow silt loam or silty clay loam. The subsoil, to a depth of about 18 inches, is reddish-brown silty clay loam. The average depth to the sandstone and shale substratum is about 30 inches, and, between the upper subsoil layer and bedrock, the soil is brownish-yellow or yellowish-brown silty clay loam or gritty clay.

This soil is difficult to cultivate, and it produces somewhat lower yields than Zanesville silt loam. When cultivated it must be very carefully protected against erosion, otherwise it will soon become unfit for use.

Zanesville silt loam, eroded phase.—The eroded phase of Zanesville silt loam is similar to the slope phase, except that it has suffered marked erosion which, in places, is evidenced by gullies to a depth ranging from 3 to 4 feet, or to the sandstone or shale bedrock. Elsewhere, or in association with the gullies, erosion has resulted in loss of the topsoil, and the land has been abandoned and allowed to grow up in briars, brush, and small trees.

Areas of this soil occur where attempts have been made to cultivate Zanesville silt loam, slope phase, without properly protecting the soil against erosion.

Pike silt loam.—Pike silt loam has a grayish-brown silt loam surface layer which is underlain, at a depth of about 5 inches, by grayish-brown silt loam tinged with yellow. This material, at a depth of about 10 inches, grades into reddish-yellow heavier silt loam which, at a depth of 15 inches, grades into brownish-red silty clay loam. This extends to a depth of 40 or more inches, where a thick layer of very silty brownish-red soil is reached. Beneath this, at a depth of about 8 feet, is a brownish-red gritty or gravelly layer which may continue to a depth of 15 feet.

This soil occurs near the bluffs of East Fork White River, and it has a somewhat lower water table than Bainbridge silt loam which it closely resembles. This may cause crops to suffer during a long dry season, but it is not an inherent characteristic of Pike soils mapped in other counties where the soil occurs in large areas. The land warms up early in the spring, allowing early seeding. It is well adapted to corn and small grains. Corn yields range from 30 to 35 bushels an acre.

Muskingum stony silt loam.—Muskingum stony silt loam is a soil of small extent occurring on the steepest hillsides, and it is unfit for anything but timber growing and pasture. The principal areas are in the southeastern and northeastern corners of the county. It is closely associated with the Zanesville soils.

The surface soil is gray silt loam containing many shale and sandstone fragments, some of which are large, and there are many rock outcrops on the surface. The subsoil, between depths of 3 and 10 inches, is grayish-yellow silt loam, and, between this and the shale or sandstone bedrock, which in most places lies at a depth of less than 3 feet, the soil material is brownish-yellow loam or sandy loam.

Included with mapped areas of this soil in the southeastern part of the county are a few small bodies that have limestone fragments on the surface and in the subsoil. Here the 3-inch surface soil consists of dark-brown sticky clay loam, and the subsoil is mottled grayish-brown and yellowish-brown clay. Most areas of this kind occur at the bases of slopes and are too wet (owing to seepage) and too stony to be cultivated.

Haubstadt silt loam.—Haubstadt silt loam is very closely associated with Bainbridge silt loam, and it is used in the same manner. The surface soil, to a depth of 7 inches, is pale grayish-yellow silt loam which, when dry, is very pale yellow. The subsoil, between depths of 7 and 15 inches, is yellow silt loam or silty clay loam, containing a few gray mottlings. This layer is variable, as it may have a red cast or it may be much mottled, but the gray mottling nowhere comprises more than 30 percent of the entire mass.

From a depth of about 15 to a depth of 23 inches the soil is yellow silt loam or silty clay loam, highly mottled with gray. Beneath this and extending to a depth of about 35 inches the texture is unchanged, but the gray mottling is more pronounced and the yellow and gray mottles make up about equal parts of the soil. The lower part of the subsoil, which continues to a depth of more than 4 feet, is yellowish-brown silty clay loam mottled with gray.

This soil is less well drained than the previously described members of this group and for this reason does not warm up so early

in the spring and cannot be cultivated so soon after a heavy rain. It is not a poorly drained soil, however, and can be farmed without artificial drainage. It does not have the brownish-red gritty lower subsoil layer that is typical of the Bainbridge soil, and this accounts for the fact that the land is slightly less well drained, resulting in a paler surface layer and the gray mottlings which occur in places at a depth ranging from 15 to 20 inches. The poorer drainage has hindered development of a good structure, and the surface soil "runs together" when wet.

This is a desirable agricultural soil, as, in addition to the fair natural drainage, it occupies nearly level relief. It is well adapted to wheat and corn. Wheat yields from 15 to 20 bushels an acre and corn 30 to 40 bushels. The soil is naturally too acid in reaction for the growth of clover but, if lime is added, yields of clover ranging from 1 to 1½ tons an acre are obtained.

Alford silt loam.—Alford silt loam is associated with Pike silt loam, but it is somewhat similar in appearance to Haubstadt silt loam. It has a 5-inch brownish-gray silt loam surface layer and a grayish-yellow silt loam subsurface layer which continues to a depth of about 12 inches. The upper subsoil layer, between depths of 12 and 25 inches, is yellow silty clay loam. Beneath this the material is mottled yellowish brown and gray.

This soil returns good yields of small grains and corn, and where the land is limed clover does well. The usual acre yields are as follows: Wheat 18 or 20 bushels, corn 30 to 35 bushels, and clover, where lime is used, 1 to 1½ tons.

Princeton fine sandy loam.—Princeton fine sandy loam occurs on dunelike formations along the bluffs of East Fork White River.

The 5-inch surface layer is gray or brownish-gray loose fine sand. The subsurface layer, between depths of 5 and 8 inches, is brown fine sand which becomes lighter and tinged with gray and, at a depth of about 14 inches, passes into heavy compact sticky dark reddish-brown clayey fine sand. Below this, at a depth of 24 or more inches, is highly calcareous gray fine sand. The thicknesses of the different horizons differ greatly, and in many places the depth to the calcareous sand is 6 feet or more. The compactness and heaviness of the subsoil also vary, and in places it is difficult to detect any heaviness. In some places a very dark sticky layer, 2 or 3 inches thick, lies just above the calcareous sand. Another variation from the typical profile occurs east of Portersville. Here the upper part of the subsoil is mottled, and the lower part is dark reddish brown.

This soil covers a very small acreage and derives its greatest importance from the fact that it is one of the few soils in this section that contains free lime at a slight depth. It is very well or excessively drained and, owing to its small area, is unimportant agriculturally, except that it is well adapted to growing cantaloups and garden crops.

Princeton silt loam.—Associated with Princeton fine sandy loam are a few small areas of Princeton silt loam. One area of the silt loam lies along the western county line about 1½ miles south of East Fork White River.

The 4-inch surface soil is grayish-brown very fine sandy loam or silt loam. The upper part of the subsoil, from a depth of about 4

to 27 inches, is brownish-yellow silt loam. Beneath this the soil gradually becomes more sandy, and, at a depth of about 8 feet, free lime is present.

Owing to its very small extent, this soil has practically no agricultural significance, but in some other counties in southern Indiana it is extensive.

Elk very fine sandy loam.—Elk very fine sandy loam is of very small extent and occurs only on the slight elevations in the East Fork White River bottoms. It is a well-drained soil that is no longer subject to overflow. It is characterized by a friable dark-brown very fine sandy loam topsoil which extends to a depth of 10 inches, where it is underlain by a lighter brown subsurface soil. This, at a depth of 16 inches, changes to brown fine sandy loam mixed with yellowish-brown loamy sand, which continues to a depth of 60 or more inches.

This is a very productive soil. It is as well drained as, has a higher organic-matter content than, and is less acid than Bainbridge silt loam. All the land is under cultivation and is well adapted to growing corn, small grains, and alfalfa.

Acre yields of corn range as high as 60 bushels, of wheat 25 or 30 bushels, and of alfalfa hay $1\frac{1}{2}$ or 2 tons.

Included with this soil as mapped, are some areas of Elk fine sandy loam, silt loam, and loam.

Tilsit silt loam.—Tilsit silt loam is of small extent in Dubois County. It is characterized by a little flatter relief than Zanesville silt loam and occupies the middles of the larger divides or occurs at the bases of the more gentle slopes.

Tilsit silt loam is characterized by a 3-inch layer of brown silt loam overlying light-brown or pale-yellow silt loam. When cultivated, the topmost 5 or 6 inches of soil become well mixed, and the material soon loses its organic matter, causing it to appear gray, especially when dry. A brownish-yellow or pale-yellow silty clay layer, very faintly mottled with grayish yellow, extends from a depth of 8 inches to a depth of 16 inches. The color of this layer in most places is solid yellow, but it may be slightly mottled. Between depths of 16 and 32 inches the material is lighter textured and is mottled brownish-yellow, yellowish-brown, and grayish-yellow silt loam. The mottlings become larger and more gray as depth increases.

This soil is not so well drained as Zanesville silt loam, but it seldom becomes waterlogged and does not erode badly where well handled. It returns good yields of corn and small grains and is highly valued in the section in which it occurs because of its smooth relief. Average crop yields are similar to those obtained on Haubstadt silt loam.

LIGHT-COLORED POORLY DRAINED SOILS OF THE UPLANDS AND TERRACES

Several soils that are not good agricultural soils have been mapped, and their unproductiveness is due principally to the fact that they are poorly drained. They are cold, are slow to warm up in the spring, their surface soils run together badly, and they are at times so wet as to cause plants to "drown out." All these soils can be

drained artificially, as their poor drainage is caused by their occurrence in very level areas. They are all light gray or gray in the surface soil, are acid, and are thoroughly leached. The native vegetation consists of deciduous trees including oaks, gums, beeches, and elms.

These poorly drained soils have been mapped as Robinson, Dubois, Johnsburg, McGary, and Iva silt loams. They are, with the exception of the Dubois and McGary soils, similar in physical characteristics and agricultural value.

Robinson silt loam.—Robinson silt loam is the dominant and characteristic soil of the "gray flats" of the northwestern part of the county. The cultivated surface soil consists of light-gray friable silt loam to a depth of 8 or 10 inches. This is underlain, to a depth of about 36 inches, by very light gray friable silt loam, slightly mottled with yellow and brown. Beneath this and extending to a depth ranging from 5 to 7 feet is light-gray silty clay loam mottled with rust brown and yellowish brown.

This soil is acid in reaction to a great depth. It is, therefore, not naturally adapted to the lime-loving crops, such as alfalfa and sweet-clover, and lime is needed for best results with red clover.

Corn and wheat are the main crops grown. Yields differ greatly, according to the season. In years when the rainfall is moderate and well distributed, yields of corn may be 50 bushels an acre, but the average is much less, about 30 bushels, and in a wet year the crop may average less than 10 bushels. Timothy and redtop are successfully grown for hay.

Some areas of Robinson silt loam are in timber. In some places the growth of trees is rather open, and some areas are used as pasture.

Johnsburg silt loam.—Johnsburg silt loam is a soil of small extent, associated with the Tilsit and Zanesville soils. In both physical appearance and agricultural characteristics it resembles Dubois silt loam and Robinson silt loam. It is predominantly gray in both surface soil and subsoil. It occurs on the large flat divides or at the heads of small drains.

The 7-inch surface soil is gray silt loam containing many small rust-brown concretions. Between depths of 7 and about 48 inches the material is mottled grayish-yellow, dull-gray, and rust-brown slightly heavier silt loam or silty clay loam. Below a depth of 4 feet and extending to bedrock, which in many places lies at a depth of about 8 feet but which may be 10 feet or more beneath the surface, is the mottled brownish-yellow and dull-gray clay loam claypan. Included with mapped areas of this soil are several small bodies, in which the surface soil is dark gray.

This soil is utilized for the most part as permanent pasture or is allowed to remain in timber. In places where it occurs at the heads of drainageways, the soil is generally too wet, owing to seepage, to be cultivated. The areas on the broader divides are sometimes cultivated with the associated Zanesville and Tilsit soils. This soil is adapted to the growth of grasses, but lime is required for the production of clover. Timothy and redtop hay will yield about 1 ton an acre. Corn, in a dry year, may yield from 40 to 50 bushels, but the average is between 20 and 30 bushels. In a wet year corn may fail entirely.

Iva silt loam.—Iva silt loam is a very unimportant soil, only a few small areas being mapped south of Lemmon School. This soil is associated with Alford silt loam, but it is too wet to be generally cultivated. It has the same general characteristics as the Dubois and Robinson soils. Owing to the smallness of the bodies, the land, where cultivated at all, is included in fields of the surrounding Alford soil.

The 15-inch surface soil is gray silt loam mottled with light grayish brown, and the subsoil, to a depth of 4 feet or more, is mottled brownish-yellow and brownish-gray silty clay loam.

Owing to the generally wet condition of this soil it impedes agriculture, as machinery cannot be used unless the land is dry. Crop yields are low, and corn averages less than 30 bushels an acre. Because this soil is so inextensive and is farmed mainly with other soils, exact yields cannot be given.

Iva silt loam, sandy phase.—The sandy phase of Iva silt loam differs from typical Iva silt loam in having a noticeable quantity of sand or fine sand in the surface soil and in its somewhat darker color. The few small bodies mapped occur as depressions within areas of Princeton fine sandy loam. These spots are very wet and of no agricultural importance except as they interfere with cultivation of the surrounding well-drained land.

Dubois silt loam.—Dubois silt loam occurs as an intermediate soil between the Haubstadt and Robinson soils. It is more poorly drained than the Haubstadt and better drained than the Robinson.

The surface soil, to a depth of 5 inches, is gray silt loam. From a depth of 5 to a depth of about 19 inches the material is mottled pale yellow and gray. The subsoil between depths of 19 and 27 inches is brownish-yellow silty clay loam streaked with gray and containing many small dark-brown or black concretions. From a depth of about 27 to 43 inches the subsoil is mottled brownish yellow and gray, and below this depth the subsoil in most places is bright brownish-yellow silty clay loam, but in a few places there is a thin layer of loam.

The slight natural drainage makes this a more productive soil than other members of this group, but crop yields are greatly increased when the land is artificially drained. Where the land is undrained, the crop yields are lower than on the Haubstadt soil, wheat averaging about 15 bushels an acre and corn about 30, but, on drained areas, yields are comparable to those obtained on the Bainbridge soil—from 20 to 25 bushels of wheat and 40 to 50 bushels of corn.

McGary silt loam.—The surface soil of McGary silt loam in cultivated fields is light grayish-brown friable smooth silt loam which extends to ordinary plow depth, below which is a layer of light-gray smooth silt loam continuing to a depth of 10 or 12 inches. The heavier part of the subsoil below this is mottled light-gray, yellow, and brown silty clay loam or silty clay. It is underlain, at a depth of about 30 inches, by calcareous clay and silt. This is a soil of very small extent and occurs only on benchlike areas along the smaller streams near the place where they enter the East Fork White River bottoms. It is agriculturally important, however, in that it contains free lime at a slight depth. In the natural condition this soil is too poorly drained to be cultivated, but when drained it is

well adapted to growing alfalfa. From 40 to 50 bushels of corn and 20 to 25 of wheat can be obtained when the land is properly drained.

DARK-COLORED POORLY DRAINED SOILS

Two soils, although mapped in only a few small bodies, are very outstanding, as they are dark colored. These are Harbison silt loam and Montgomery silty clay loam. They are, owing to their high content of organic matter, excellent soils for corn and good general farming soils when properly drained.

Harbison silt loam.—Harbison silt loam occurs in the section of smooth relief and is associated with the Dubois and Robinson soils. The 10-inch surface layer is dark-gray or black silt loam. Between depths of 10 and 24 inches the dark-gray silt loam or silty clay loam subsurface layer is lighter colored but contains some organic matter. Beneath this and extending to a depth of 4 feet or deeper, the material is gray sandy clay.

Undrained areas of this soil are used for pasture or are left in timber, but, if the land is properly drained, yields of corn may exceed 50 bushels an acre and wheat 25 bushels. Small grains, especially oats, are likely to lodge.

Montgomery silty clay loam.—Montgomery silty clay loam is a soil of very small extent. It occurs only on the benchlike terrace or back-water position along East Fork White River. The surface soil is dark-gray silty clay loam which gradually becomes less dark with depth and is underlain, at a depth ranging from 10 to 15 inches, by mottled gray, yellow, and brown smooth silty clay. Free lime is present in small quantities at a depth of about 4 feet and is very abundant at a depth of 5 feet. The surface soil is alkaline.

This soil is of little agricultural significance, as it is not extensive. Where the land is drained, however, corn will yield from 50 to 60 bushels an acre.

SOILS DEVELOPED FROM ALLUVIUM

The soils of Dubois County that have developed from alluvium may be divided into two groups—those in the East Fork White River flood plain and those along Patoka River and the smaller streams.

The soil materials in the East Fork White River flood plain were largely transported from areas where the substratum is either calcareous glacial drift or limestone, and they are, with the exception of Tyler silty clay loam and its brown phase, not acid. Along Patoka River and the smaller streams, however, the sediments come from the neighboring hills, on which practically all the soil materials are acid, and the sediments derived from them are acid.

The soils of the East Fork White River bottoms have been divided into seven soil types and phases: Genesee loam, Genesee silt loam, Genesee fine sandy loam, Tyler silty clay loam, Tyler silty clay loam, brown phase, Eel silty clay loam, and Eel silty clay loam, meander phase. Of these, Tyler silty clay loam, brown phase, is the most extensive and, even though it lies in an area of normally alkaline soils, is slightly acid.

These soils, with the exception of Tyler silty clay loam, Eel silty clay loam, and Eel silty clay loam, meander phase (which is too wet

to cultivate), are excellent corn soils. They contain a medium quantity of organic matter, and, although they are well drained, the water-holding capacity is sufficiently high that plants do not often suffer from lack of moisture.

The soils on the flood plains of Patoka River and smaller streams have been divided into six soil types and phases: Holly silt loam, Holly silt loam, dark-colored phase, Stendal silty clay loam, Pope loam, Waverly silt loam, and Waverly silty clay loam.

Genesee silt loam.—Genesee silt loam has a dark-brown or rich-brown mellow silt loam surface soil, which is evidence of a rather abundant supply of organic matter. The subsoil is brown friable silt loam. Both surface soil and subsoil are neutral or alkaline in reaction, with free lime present in a few places. Drainage is good. These characteristics in a soil that is very easily penetrated by plant roots indicate a very productive soil, and this is one of the most productive in Dubois County. Large yields of corn (50 to 60 bushels an acre) and alfalfa, as well as small grains, are obtained where the land is protected against overflows in late spring and summer. Such overflows are now comparatively infrequent and seldom are responsible for crop failure.

Genesee fine sandy loam.—Genesee fine sandy loam, like Genesee silt loam, occurs only in the first bottoms of East Fork White River. It has a dark-brown fine sandy loam surface soil underlain, at a depth of 8 or 10 inches, by brown or yellowish-brown fine sandy loam. The sand content varies considerably, and the areas mapped are in part fine sand and in part loamy fine sand.

The areas occur as linear strips near the river, in fact they form the natural stream levees built up by successive overflows. Drainage is good. The soil is readily workable early in the season, except as floods may interfere, has good tilth, is fertile and sweet, and is very productive of corn and alfalfa. It is probably not quite so fertile as Genesee silt loam, but its texture and position are more favorable to good drainage.

Genesee loam.—Genesee loam is intermediate in texture between Genesee silt loam and Genesee fine sandy loam. Except for a somewhat lighter texture, owing to a higher content of fine sand, it is similar to Genesee silt loam and has a brown surface soil and subsoil. It is somewhat more readily worked, except as floods interfere, but yields of corn, alfalfa, and other crops commonly grown on the bottom lands are similar. The total area of Genesee loam is small. This soil is associated with the other Genesee soils in the first bottoms of East Fork White River.

Tyler silty clay loam.—Tyler silty clay loam occurs in small poorly drained depressions in the well-drained bottoms of East Fork White River. It is characterized by an olive-gray silty clay loam surface soil faintly mottled with light gray, which, at a depth of 12 inches, grades into steel-gray silt loam containing a few vertical streaks of rust brown. At a depth of 30 inches, the material again becomes silty clay loam and is moderately mottled with rust brown, but the mottlings increase in number and size with depth. The soil is acid throughout. Some areas are so wet that cultivation is difficult, but the land is suitable for pasture.

Tyler silty clay loam, brown phase.—Tyler silty clay loam, brown phase, is less well drained than the Genesee soils and some-

what better drained than typical Tyler silty clay loam. It has a brown surface soil and a mottled gray and yellow heavy subsoil. This soil occurs on the broad flats away from the river bank and close to the upland. It is a little cold in spring, but, except in years marked by late spring freezes or very heavy rainfall, the growing season is sufficiently long to mature a good corn crop. This soil occurs in a high-bottom position, and wheat can sometimes be grown. At times unusually heavy floods cover the land.

Eel silty clay loam.—Eel silty clay loam is an imperfectly drained soil of the East Fork White River bottoms, associated with the Genesee soils, and is subject to overflow. It occurs in the lower bottoms and may in places be slightly acid, owing to seepage and coluvial wash. It consists of brownish-gray silty clay loam underlain by dark-gray silty clay loam or clay loam. The lower part of the subsoil is streaked and mottled with light gray and yellow and, at a depth of about 30 inches, is stained with rusty brown. This land is used for pasture or the production of timber.

Eel silty clay loam, meander phase.—Eel silty clay loam, meander phase, is of a very small extent. It occurs in the old meanders of East Fork White River and is nonagricultural, as it is usually saturated and frequently submerged. It is a brownish-gray soil containing a few lighter gray streaks, and it becomes spotted with soft rusty-brown concretions and lighter gray spots at a depth of 6 inches. Below this depth, the light gray becomes more pronounced. The present forest cover is largely willow, walnut, sycamore, and elm.

Holly silt loam.—Holly silt loam is the most extensive soil developed from alluvium in Dubois County. It occurs in the first bottoms of Patoka River and the smaller streams. This soil is moderately well drained and is acid throughout. The surface soil is dark-brown silt loam to a depth of about 15 inches. The subsoil to a depth of 5 feet or more is mottled brown, brownish-yellow, and gray silt loam or silty clay loam. This soil contains no claypan to restrict drainage, but its location on the low flats results in a high water table which keeps a supply of moisture within easy reach of plants.

In most places the spring floods inundate all the larger alluvial plains, but the water recedes in time to allow corn to be planted and to mature. Yields of corn range from 50 to 60 bushels an acre. Wheat is seldom sown on the larger bottoms, as it would be drowned out by the spring floods. Oats and hay are sometimes grown on this soil, and high yields are obtained.

Holly silt loam, dark-colored phase.—Holly silt loam, dark-colored phase, designates areas of first-bottom land occurring along Patoka River and the smaller streams of the county, which differ from typical Holly silt loam in having somewhat poorer drainage and a darker colored surface soil.

The surface soil, to a depth of 6 or 8 inches, is dark-brown or dark grayish-brown friable silt loam with a noticeable content of organic matter. The subsoil is yellowish-brown or mottled yellow, brown, and gray heavy silt loam or silty clay loam. The lower part of the subsoil is everywhere mottled, giving evidence of imperfect drainage.

Soil of the dark-colored phase has about the same crop value as typical Holly silt loam, with possibly somewhat higher average

fertility, owing to a higher content of organic matter in the surface soil.

Stendal silty clay loam.—Stendal silty clay loam is less well drained than Holly silt loam and, therefore, is not so productive. Most of this soil occurs at some distance from the streams and only in the larger and wider bottoms. Fully 90 percent of it is in the flood plain of Patoka River. The land is less well drained than Holly silt loam, both because of its silty clay loam texture which hinders percolation and because it has a high water table owing to its position near the valley walls.

The surface soil is brownish-gray silty clay loam mottled with gray and rust brown. When dry, the material at the immediate surface appears lighter gray and is compact. Included with this soil as mapped are small areas of silt loam, which are too mottled to be included in Holly silt loam and too small to separate as a phase. This soil is acid throughout. It is poorly drained but in most places can be tiled and made productive.

In favorable years good yields of corn, oats, and hay are produced. Much of the land, however, is left in timber, and some is used for growing wild hay.

Pope loam.—Pope loam, a well-drained acid soil similar in color to the Genesee soils, occurs in narrow strips along the larger streams and near the heads of the small swiftly flowing streams. Nowhere does it occupy a large enough area to be of great agricultural importance, but it is recognized as a very productive soil. It is better drained and contains less organic matter than Holly silt loam and is lighter in color, being rich brown to a depth of 20 or more inches. It contains sufficient organic matter to produce good crops of corn, oats, and hay, but wheat is seldom grown, on account of the danger of floods. Most of this soil occurring along Patoka River is in timber. In this position it serves as a natural levee and prevents destructive washing.

Waverly silt loam.—Waverly silt loam is poorly drained and, in most places, not adapted to cultivated crops. It occurs in the larger stream bottoms, away from the streams or in the inside curves of meanders. As the areas are very poorly drained, some of them even marshy, they are left in timber or used as pasture.

The surface soil consists of light-gray silt loam, with staining or mottling of yellow and brown. The content of organic matter is small, and a cultivated field, when dry, appears nearly white. The subsoil is mottled yellow and gray silt loam, with the gray predominant. In places, silty clay loam, clay, or more compact layers, which retard water movement, occur in the lower part of the subsoil.

Waverly silty clay loam.—Waverly silty clay loam is similar to Waverly silt loam in location and physical characteristics. It has a somewhat higher clay content, which causes it to be more difficult to drain and cultivate. Its best use under present conditions is for such pasturage as may be obtained from it and for timber growing. Its total area is very small.

MUCK

Muck consists of black well-decomposed organic matter which extends to a depth of 2 feet or deeper. It was accumulated under conditions of poor drainage and, until it can be artificially drained,

will have little or no agricultural value, except for pasture. In this county, muck contains much alluvial or colluvial mineral material, largely silt. The total area is small, and the land is not cultivated.

SOILS AND THEIR INTERPRETATION

The well-drained, well-developed soils of Dubois County belong in the broad soil group known as the Gray-Brown Podzolic soils. All, with the possible exception of some areas of the dark-colored soils, were originally forested. Local soil differences are largely owing to variations in relief, drainage, and parent materials. The soils can be divided into two groups on the basis of pedologic characteristics. These are: Group 1, soils with complete profile development; and group 2, soils with partial profile development. The soils of group 1 have well-defined color, structure, texture, and chemical characteristics. The soils of group 2 lack one or more of the characteristic features of the completely mature profile.

The soils of group 1 are characterized by an eluvial A horizon, an illuvial B horizon, and a weathered C horizon. In some soils other horizons are present, namely, a heavier or more compact horizon with prismatic structure and a friable horizon that in most places contains many dark-colored concretions and has no prismatic structure. This light-textured horizon lies directly above the parent material. Both the A and B horizons are leached of free bases and carbonates. The A horizon contains a relative concentration of silica, and the B horizon shows a relative concentration of alumina and iron. The C horizon is variable in composition, consisting of sandstone and shales, lacustrine deposits, glacial drift, or loess. The glacial drift and loess are of very small extent in Dubois County. In isolated spots in the northeastern and southeastern corners of the county, limestone outcrops, but it is thin and does not materially affect the soil.

The A horizons are lighter textured than the B horizons. In most places they also show a platy structure, whereas the B horizons are typically characterized by an angular nut structure. The C horizons have no consistent structure.

Group 1 may be subdivided into two subgroups, as follows: Subgroup A, well-drained soils with normally developed regional profiles; and subgroup B, imperfectly drained soils and poorly drained soils.

The soils of subgroup A, or the well-drained soils with complete profiles, occur on undulating or gently rolling relief and include the Zanesville, Haubstadt, Bainbridge, Elk, Princeton, and Pike soils. Of these, the Zanesville soils are representative, as well as being the most extensive soils in the county. The soil material is residual from sandstones and shales.

Following is the description of a profile of Zanesville silt loam, as observed $1\frac{1}{2}$ miles north of Bretzville:

1. 0 to 2 inches, dark-brown friable silt loam with a well-developed platy structure. When this material is broken across the cleavage planes, many fine pores or vesicles are readily seen.
2. 2 to 6 inches, yellowish-brown silt loam with a platy structure. The faces of the cleavage planes appear darker than the interiors of the laminae. The lower part of the layer shows the beginning of a granular structure.

3. 6 to 10 inches, reddish-brown silty clay loam or heavy silt loam. The material at a fresh or broken surface is reddish brown, but at a scraped surface is yellowish brown. The soil has a friable fine angular nut structure but traces of platy structure may be seen, especially in the upper part of the layer.
4. 10 to 20 inches, reddish-brown or reddish-yellow silty clay loam, slightly heavier than in the layer above and with a more pronounced red cast. The fine nut structure is well developed, and the particles average less than one-fourth inch in diameter.
5. 20 to 28 inches, brownish-yellow firm silt loam mottled with grayish yellow and brownish gray. The material contains a considerable quantity of very fine sand. The material at a fresh broken surface is yellowish brown but at a scraped surface is lighter colored and more yellow. Vertical cleavage planes are faintly developed, but the predominating structure particle is angular and about 1 inch in diameter.
6. 28 to 36 inches, highly mottled grayish-yellow, grayish-brown, and yellowish-gray silt loam containing a considerable quantity of very fine sand. This layer contains many small dark rust-brown concretions that are darkest at the center. Irregular gray streaks, which occur mostly along vertical cleavage planes, are present, and they are independent of the mottlings. The gray streaks seem to be almost pure silt. The structure is prismatic, with vertical cleavage planes well developed.
7. 36 to 48 inches, dark grayish-brown compact silt loam mottled with dark brownish gray and yellowish brown. This layer also has large gray silty seams along the cleavage planes. The material in this horizon is very compact, and natural cleavage planes are very well developed. The material at a fresh broken surface is very dark brown but at a scraped surface is yellowish brown.
8. 48 to 60 inches, a mottled yellowish-gray and brownish-yellow friable mixture of fine sand, silt, and clay, containing numerous partly weathered fragments of sandstone.
9. 60 to 70 inches +, mottled grayish-yellow and brownish-yellow indurated sandy clay containing many partly decomposed rock fragments.

Under cultivation, the first two layers become mixed and form an A horizon of light grayish-brown silt loam. The soil reaction is strongly acid throughout, except in the surface layer which is slightly acid.

Variations from this profile are neither numerous nor important. One of the most common is the depth to bedrock, which ranges from 3 to 10 feet. The most striking variation is at Maultersville Crossroad where the material of horizon 7 is deep brownish-red gritty clay. The color is probably due to a difference in the composition of the parent rock.

The other members of this subgroup have the same general profile, but they differ mainly in the character of the parent material.

The Bainbridge soils have redder B horizons than the Zanesville, but the chief difference between soils of the two series is the brick-red or brownish-red indurated gritty clay loam or loam which, in the Bainbridge soils, occurs below a depth of about 4 feet. The Bainbridge soils also differ from the Zanesville in that they are developed from lake deposits, rather than from weathered shales and sandstones. Haubstadt silt loam is also developed from lacustrine deposits, but it lacks the red layer characteristic of the Bainbridge soils.

The Elk soils are formed from deposits of alluvium, which are above the level of overflow. They are old enough to have developed the regional soil profile, but it is less pronounced than in the Zanesville soil. The textural difference between the A and B horizons is less marked. The color of the B horizon is faint, and the granular structure is not so well developed.

The Princeton soils are developed from calcareous wind-blown materials and are among the few soils in Dubois County that contain free lime in the parent material. The B horizon in many places is heavy and sticky, even in the sandy types, and the color is rich dark brown, with the deepest color occurring immediately above the calcareous parent material.

Pike silt loam is developed from silts which overlie Illinoian glacial till. The till is leached to a great depth. A profile of this soil was observed to a depth of 17 feet, and no evidence of free lime was found.

The soils of subgroup B, which, from the point of view of soil morphology, are imperfectly drained or poorly drained soils with complete profile development, occur on gentle slopes, and nearly level areas. They include the Dubois, Tilsit, Alford, Johnsburg, Robinson, Iva, and McGary soils.

Dubois silt loam is an extensive soil of this subgroup. It occurs in the northwestern quarter of the county, where the relief ranges from smooth to gently undulating.

Following is a description of a profile of Dubois silt loam, as observed 1 mile west of Ireland.

1. 0 to 3 inches, dark-gray silt loam slightly platy and showing vesicular structure, with the largest vesicles at the lower limit of the layer.
2. 3 to 19 inches, pale-yellow silt loam somewhat streaked with gray. Numerous dark concretions are in the lower part of this layer. The structure is platy, with fine granules beginning to develop at the lower limit.
3. 19 to 27 inches, brownish-yellow light silty clay loam streaked with gray and containing dark rusty-brown concretions. The structure is fine angular nut, the particles averaging about one-fourth inch in diameter. There is some suggestion of vertical cleavage planes, especially in the lower part of the horizon.
4. 27 to 43 inches, mottled brownish-yellow and gray silty clay loam, in which the mottling consists of about equal parts of each color. Vertical cleavage (prismatic structure) is well developed. Streaks of gray silty material, which are independent of mottling, occur along the cleavage planes.
5. 43 to 60 inches, bright brownish-yellow loam slightly mottled with gray. The soil material when crushed and kneaded is bright brownish yellow.
6. 60 to 65 inches, mottled reddish-brown and gray silty clay loam with dark rusty-brown concretions. This horizon is not consistent, as it does not occur in other places nearby.
7. 65 to 91 inches, bright brownish-yellow heavy loam mottled with gray. The soil material when kneaded is bright brownish yellow.
8. 91 to 104 inches+, yellowish-brown clay loam containing many very dark brown and black concretions.

The soil material is acid or strongly acid throughout. The last layer may be regarded as the parent material. Layer 7 is interesting in that a similar layer occurs in many places in the soils of the more poorly drained uplands in southern Indiana, regardless of the character of the parent material. This soil is developed from noncalcareous lake-laid deposits, and the true parent material is recognized with difficulty. The variations in texture, however, below a depth of 60 inches are inherited from the parent material and are not due to soil-forming processes.

Other soils in this subgroup differ in various details from Dubois silt loam. The Tilsit and Johnsburg soils are developed from sandstone and shale material, the Alford and Iva soils from deep silts

which overlies glacial drift of Illinoian age, and McGary silt loam from calcareous slack-water deposits.

Table 4 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of Alford silt loam.

TABLE 4.—*Mechanical analyses of Alford silt loam*

Sam- ple no.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Percent	Percent	Percent	Percent	Percent	Percent	Percent
2838116	Surface soil, 0 to 1 inch.....	0.3	0.5	0.8	1.6	2.8	78.8	17.2
2838117	Subsurface soil, 1 to 5 inches..	.1	.4	.6	1.3	2.3	76.7	18.6
2838118	Subsoil, 5 to 12 inches.....	.1	.5	.5	1.3	1.6	77.2	18.9
2838119	Subsoil, 12 to 18 inches.....	.1	.2	.3	.6	1.5	65.1	32.2
2838120	Subsoil, 18 to 25 inches.....	.2	.6	.7	1.4	2.3	65.1	29.6
2838121	Subsoil, 25 to 40 inches.....	.3	.8	1.1	2.0	2.9	64.9	28.0
2838122	Subsoil, 40 to 80 inches.....	.9	.4	2.0	4.3	5.3	60.5	26.6
2838123	Subsoil, 80 to 95 inches.....	1.4	3.5	3.6	7.2	7.2	38.6	38.4
2838124	Subsoil, 95 to 105 inches.....	1.6	3.0	3.1	6.0	6.8	46.1	33.5

Robinson silt loam is another extensive and representative soil of the subgroup. It occurs in the very flat or slightly depressed areas of the old lake plain. This soil is wet and cold, and much of it is forested with white oak, chestnut oak, sweetgum, and beech, together with smaller numbers of elm, black gum, and red oak.

Following is a description of a profile of Robinson silt loam as observed 2 miles south of Jasper:

- 0 to 2 inches, gray silt loam darkened by humus and variegated in color, due to the presence of darker worm casts and rust-brown spots. This layer contains roots and other fragments of undecomposed organic matter and has about a ¼-inch covering of leaf litter on the surface.
- 2 to 8 inches, gray or light-gray silt loam containing small dark concretions and a small amount of humus. The material contains some worm casts and is somewhat vesicular or porous. It also contains some fine roots, and the grayest soil surrounds these roots.
- 8 to 24 inches, light-gray silt loam with slight yellow mottlings and rust-brown stains. The material is somewhat vesicular.
- 24 to 36 inches, slightly heavier light-gray silt loam with yellowish-brown specks and mottlings. Fine vesicular cavities lined with rusty brown are present, as are also some rusty-brown concretions. This horizon does not have a well-developed fine-nut, or normal, B structure, but it is faintly developed.
- 36 to 49 inches, light-gray silty clay loam, decidedly heavier than the material in the layers above, mottled with rust brown and yellowish brown. This material breaks into a fine angular nut structure with particles about one-fourth inch in diameter. It also contains fine round vesicles lined with rust brown.
- 49 to 65 inches, mottled yellowish-brown, rust-brown, and light-gray heavy silty clay loam containing many large soft black concretionary masses. Vertical cleavage planes are well developed.
- 65 to 72 inches, mottled light-gray, yellow, and yellowish-brown heavy silt loam. The material contains some coarse vesicles but breaks into large angular fragments about 1 inch in diameter.
- 92 to 150 inches +, same material as in layer above, except that it is less acid.

The soil material is strongly acid throughout, except in the lowest horizon described, which is medium acid.

As indicated above, this soil does not have a normally developed B horizon, although a distinctly heavier layer begins at a depth of 36 inches. This layer is comparatively impermeable to water,

and this characteristic contributes to the poor drainage of the overlying soil material.

The soils of group 2 or soils with partial profile development, are those in which one or more features of the chemical, structural, textural, or color profiles are absent or only incipiently developed. The features missing in most places are the development of the textural and structural horizons.

This group may be divided into three subgroups, as follows: Subgroup A, shallow soils on slopes; subgroup B, alluvial soils; and subgroup C, humous soils.

The soils of subgroup A occur on the steeper slopes, where removal of the products of weathering and soil development by erosion have nearly kept pace with the accumulation of soil material. This condition has inhibited the development of the normal soil profile of the region, and the soil material consists of disintegrated rock, without definite arrangement in soil horizons. In Muskingum stony silt loam, which is derived from sandstone and shale, some darkening of the thin surface layer by organic matter and the development of a yellow color by oxidation in the loose mineral material have taken place. Fragments of bedrock occur throughout the soil material and on the surface.

The soils of subgroup B occur on the flood plains of the many small streams and of East Fork White and Patoka Rivers. No real profile, except the color profile, has developed, which is largely determined by drainage conditions. This subgroup can be divided further into neutral or alkaline soils developed from alluvium washed from recent glacial deposits and from weathering limestone and deposited in the East Fork White River bottom; and acid soils formed from the alluvial wash from residual sandstone and shale and other noncalcareous deposits occurring in the bottoms of Patoka River and many smaller streams. Any of these soils may have textural layers, but they are inherited and not due to processes of soil development.

The neutral or alkaline alluvial soils are mapped as Genesee fine sandy loam, Genesee loam, and Genesee silt loam, which are well drained; and Eel silty clay loam and Eel silty clay loam, meander phase, which are imperfectly drained.

The acid alluvial soils are mapped as Pope loam which is a well-drained soil; Holly silt loam, Holly silt loam, dark-colored phase, Tyler silty clay loam, and Tyler silty clay loam, brown phase, which are moderately well drained soils; and Stendal silty clay loam, Waverly silt loam, and Waverly silty clay loam, which are poorly drained soils.

The soils of subgroup C, or the humous soils, formed in low wet places where conditions were favorable for the accumulation of organic matter, include Harbison silt loam, Montgomery silty clay loam, and muck.

The Harbison and Montgomery soils are very similar, in that they have very dark surface soils and mottled gray and yellowish-gray subsoils which are spotted with rust brown.

Harbison silt loam is associated with the Robinson and Dubois soils on the lake plain. Montgomery silty clay loam is associated with McGary silt loam, and it contains free lime at a depth of about 5 feet. Muck consists of the remains of swamp vegetation, with

layers of sand interbedded in the organic matter below a depth of about 5 feet.

THE MANAGEMENT OF DUBOIS COUNTY SOILS *

The farmer should know his soil and have a sound basis for every step in its treatment. Building up the productivity of a soil to a high level, in a profitable way, and then keeping it up is an achievement toward which every farmer should strive. Different soils present different problems as to treatment, and these must be studied and understood, in order that crops may be produced in the most satisfactory and profitable way.

The purpose of the following discussion is to call attention to the deficiencies of the several soils of the county and to outline in a general way the treatments most needed and most likely to yield satisfactory results. No system of soil management can be satisfactory unless in the long run it produces profitable returns. Some soil treatments and methods of management may be profitable for a time but ruinous in the end. One-sided or unbalanced soil treatments have been altogether too common in the history of farming in the United States. A proper system of treatment is necessary in making a soil productive.

CHEMICAL COMPOSITION OF DUBOIS COUNTY SOILS

Table 5 gives the results of chemical analyses of the different types of soil in Dubois County, expressed in pounds of elements in 2,000,000 pounds of plowed surface soil of an acre.

TABLE 5.—*Chemical composition of Dubois County, Ind., soils*

[Elements in pounds per acre of surface soil 6 to 7 inches deep]

Soil no.	Soil type	Phosphorus ¹	Potassium ¹	Calcium ¹	Magnesium ¹	Manganese ¹	Aluminum ¹	Iron ¹	Sulphur ¹	Phosphorus ²	Potassium ²	Nitrogen ²	Potassium ²
10	Johnsburg silt loam.....	960	3,360	2,430	2,770	2,300	46,100	37,800	480	26	168	2,200	25,220
8	Tilsit silt loam.....	960	4,370	1,860	2,050	3,310	52,500	36,500	480	18	186	2,200	30,770
24	Zanesville silt loam.....	786	5,045	1,860	2,900	1,730	45,700	28,200	320	18	185	2,000	32,120
51	Muskingum stony silt loam.....	874	4,540	1,570	2,290	1,580	37,700	28,000	320	26	202	2,400	23,880
49	Bainbridge silt loam.....	874	5,380	2,000	2,176	2,300	38,400	27,200	320	26	151	2,000	34,300
57	Robinson silt loam.....	786	3,360	2,290	1,210	580	37,300	20,100	320	62	101	1,800	27,070
7	Dubois silt loam.....	786	3,027	2,285	2,410	1,870	40,600	30,800	400	26	185	1,800	23,200
2	Haubstadt silt loam.....	700	3,027	1,860	2,410	1,730	31,800	30,000	240	18	200	1,600	30,770
20	Iva silt loam.....	700	3,363	3,290	2,050	1,300	32,600	28,360	320	35	135	1,800	27,910
44	Alford silt loam.....	612	4,204	2,000	2,170	1,870	42,200	27,300	400	18	150	1,800	33,960
30	Pike silt loam.....	786	5,220	2,290	1,930	1,685	42,600	37,200	320	26	250	2,000	25,900
14	Princeton fine sandy loam.....	700	3,870	4,000	2,900	1,010	24,000	26,200	320	79	168	1,400	27,580
1	Elk very fine sandy loam.....	1,050	5,210	4,000	4,580	1,150	25,300	35,200	320	52	303	2,000	26,560
29	McGary silt loam.....	874	6,220	3,860	3,020	1,680	53,800	41,600	480	18	202	2,000	27,740
13	Waverly silt loam.....	874	4,540	2,000	2,770	1,010	47,700	32,100	400	26	150	2,000	26,560
13	Waverly silty clay loam..	1,136	4,540	2,000	2,170	800	55,300	36,000	500	18	168	1,800	25,900
28	Stendal silty clay loam..	874	5,380	3,140	3,140	1,440	59,400	30,000	320	26	185	2,000	30,270
31	Holly silt loam.....	874	5,835	1,714	2,900	1,440	48,800	35,200	400	18	185	1,800	26,900

¹ Soluble in strong hydrochloric acid (specific gravity 1.115).

² Soluble in weak nitric acid (fifth-normal).

³ Total elements.

* This section of the report was written by A. T. Wiancko and S. D. Conner, department of agronomy, Purdue University Agricultural Experiment Station.

TABLE 5.—*Chemical composition of Dubois County, Ind., soils—Continued*

[Elements in pounds per acre of surface soil 6 to 7 inches deep]

Soil no.	Soil type	Phosphorus	Potassium	Calcium	Magnesium	Manganese	Aluminum	Iron	Sulphur	Phosphorus	Potassium	Nitrogen	Potassium
28D	Holly silt loam, dark-colored phase.....	874	3,870	5,286	3,380	860	43,200	18,800	480	61	202	3,200	28,420
21	Pope loam.....	700	3,700	2,430	2,650	1,010	40,300	26,000	480	26	101	1,600	26,740
11	Harbison silt loam.....	1,920	5,045	2,860	2,290	290	63,100	20,300	400	175	320	4,400	29,930
3	Tyler silty clay loam.....	1,480	6,900	4,140	5,070	860	56,700	36,500	400	114	336	2,800	30,270
28W	Tyler silty clay loam, brown phase.....	1,220	6,890	3,710	4,100	1,730	54,500	40,000	400	35	202	2,200	33,960
15	Montgomery silty clay loam.....	1,480	13,960	8,570	3,378	1,308	89,800	55,800	560	79	320	3,600	41,870
54	Eel silty clay loam.....	1,570	10,420	6,000	2,530	1,730	73,700	49,900	500	105	303	2,800	35,820
47	Genesee silt loam.....	1,220	9,420	4,710	3,620	1,730	63,600	40,800	480	35	168	2,800	32,280
12	Genesee loam.....	960	5,880	10,000	6,880	1,010	42,200	34,300	480	52	219	2,000	27,740
37	Genesee fine sandy loam.....	874	6,730	20,570	5,070	1,010	39,900	25,700	240	105	135	1,600	25,050
M	Muck.....	1,180	2,186	22,280	1,146	1,008	28,600	3,200	1,310	130	84	17,100	7,230

Three groups of analyses are given as follows: Total plant-nutrient elements, elements soluble in strong (specific gravity 1.115) hydrochloric acid, and elements soluble in weak (fifth-normal) nitric acid.

The total plant-nutrient content is more indicative of the origin and age of a soil than of its fertility. This is particularly true of potassium. The amount of total potassium in a soil is seldom an indication of its need for potash. Some Indiana soils which have more than 30,000 pounds of total potassium to the acre in the 6-inch surface layer fail to grow corn without potash fertilization, because so little of the potassium they contain is available.

The total content of nitrogen is generally indicative of the need for nitrogen, although some soils with a low total may have a supply of available nitrogen sufficient to produce a few large crops without the addition of that element. Soils having a low total nitrogen content soon wear out, so far as that element is concerned, unless the supply is replenished by growing and turning under legumes or by the use of nitrogenous fertilizer. The darker colored soils are, in general, higher in organic matter. Organic matter and nitrogen are closely associated in soils, hence it is a rule that the darker a soil is the richer it is in nitrogen.

The amount of total phosphorus in ordinary soils is usually about the same as that shown by a determination with strong acid. For this reason a separate determination of total phosphorus has been omitted. The supply of total phosphorus usually indicates the general need of a soil for phosphatic fertilizers.

The amount of phosphorus soluble in weak acid is considered by many authorities as a still better indication of the phosphorus needs of a soil. The depth of a soil may modify its need for phosphates. Everything else being equal, the more soluble phosphorus a soil contains the less it is apt to need phosphate fertilizers. Where the soluble phosphorus runs less than 100 pounds to the acre, phosphates are usually needed for high crop yields.

The quantity of potassium soluble in strong or weak acid is to some extent significant. This determination, however, is not so reliable

an indicator as is the determination of phosphorus, particularly with soils of high lime content. Sandy soils and muck soils are more often in need of potash than clay and loam soils. Poorly drained soils and soils with impervious subsoils usually need potash more than well-aerated deep soils.

The use of strong or weak acid in the analysis of a soil has sometimes been criticized, yet such analyses can more often be correlated with crop production than can analyses of the total elements of the soil. For this reason acid solutions have been employed in these analyses.

It must be admitted, however, that no one method of soil analysis will definitely indicate the deficiencies of a soil. For this reason these chemical data are not intended to be the sole guide in determining the needs of the soil. The depth of the soil, the physical character of the entire soil profile, and the previous treatment and management of the soil are all factors of the greatest importance and should be taken into consideration. Pot tests indicate that nitrogen and phosphorus are much less available in the subsurface soils and subsoils than they are in the surface soils. On the other hand, potash in the subsoil seems to be of relatively high availability. Crop growth depends largely on the amount of available plant nutrients with which the roots may come in contact. If the crop can root deeply, it may be able to make good growth on soils of relatively low analysis. If the roots are shallow, the crop may suffer from lack of nutrients, particularly potash, even on a higher analysis soil. The better types of soils and those containing large amounts of plant-nutrient elements will endure exhaustive cropping much longer than the soils of low plant-nutrient content.

The nitrogen, phosphorus, and potassium contents of a soil are by no means the only chemical indications of high or low fertility. One of the most important factors in soil fertility is the degree of acidity. Soils which are very acid will not produce well, even though there be no lack of plant-nutrient elements. Though nitrogen, phosphorus, and potassium are of some value when added to acid soils, they will not produce their full effect where lime is deficient. Table 6 shows the percentage of nitrogen and the acidity of the various soils in Dubois County. The acidity is expressed as pH, or intensity of acidity. Neutrality is expressed by pH 7, and a soil with a pH value of 7 contains just enough lime to neutralize the acidity. If the pH is more than 7, it means that there is some excess of lime. From pH 6 to pH 7 shows slight acidity, and from pH 5 to pH 6 medium acidity. If the pH runs below 5, the soil is strongly acid. As a rule, the stronger the acidity the more a soil needs lime. Samples were taken from the surface soil (0 to 6 inches), from the subsurface soil, and from the subsoil. It is important to know the reaction, not only of the surface soil but of the lower layers of the soil as well. Given two soils of the same acidity, the one with the greater acidity in the subsurface layer is in greater need of lime than the other. Furthermore, the more nitrogen a soil contains and the greater the depth to which this element extends, the less will be the need for lime. The slighter the depth of acid soil, the less it is apt to need lime. So, in determining how badly an acid soil may need lime, it is necessary to know the pH, or intensity of acidity, also the amount of nitrogen and organic matter

which accompanies it. The less phosphorus, calcium, and magnesium in the soil, the more it is apt to need lime. It is well to remember that sweetclover, alfalfa, and red clover need more lime than other crops. As it is advisable to grow these better soil-improvement legumes in the rotation, it is in many places desirable to lime the land so that sweetclover or alfalfa will grow.

TABLE 6.—*Nitrogen and acidity of Dubois County, Ind., soils*

Soil no.	Soil type	Depth	Nitrogen	pH	Average depth of acid soil	Indicated lime requirement per acre
		<i>Inches</i>	<i>Percent</i>		<i>Inches</i>	<i>Tons</i>
10	Johnsburg silt loam.....	0-6 7-18 19-40	0.11 .05 .03	5.4 4.6 4.8	(¹)	2-3
8	Tilsit silt loam.....	0-6 7-15 16-38	.11 .07 .03	5.0 4.6 4.6	(¹)	2-3
24	Zanesville silt loam.....	0-6 7-15 16-36	.10 .05 .03	5.6 5.3 4.9	(¹)	2-3
51	Muskingum stony silt loam.....	0-6 7-10 11-22	.12 .07 .06	4.8 4.8 4.6	(¹)	2-3
49	Bainbridge silt loam.....	0-6 7-15 16-30	.10 .06 .04	5.7 5.5 5.0	(¹)	2-3
44	Alford silt loam.....	0-6 7-15 16-33	.09 .05 .03	5.6 5.3 5.0	60	2.3
30	Pike silt loam.....	0-6 7-18 19-36	.10 .06 .04	5.5 5.6 5.0	60	2-3
57	Robinson silt loam.....	0-6 7-17 18-34	.09 .07 .04	5.4 4.6 4.4	60	2-3
7	Dubois silt loam.....	0-6 7-15 16-28	.09 .04 .03	5.4 4.8 4.7	60	2-3
2	Haubstadt silt loam.....	0-6 7-15 16-34	.08 .04 .02	5.6 5.2 4.4	60	2-3
20	Iva silt loam.....	0-6 7-18 19-38	.09 .05 .03	5.7 5.0 4.9	50	2-3
14	Princeton fine sandy loam.....	0-6 7-17 18-36	.07 .03 .02	6.0 6.1 5.9	60	1-2
1	Elk very fine sandy loam.....	0-6 7-15 15-28	.10 .08 .04	6.2 6.5 6.3	120	1-2
13	Waverly silt loam.....	0-6 7-18 19-36	.10 .05 .03	5.0 4.8 4.8	72	1-2
13	Waverly silty clay loam.....	0-6 7-18 19-36	.09 .07 .05	5.2 4.9 4.8	72	1-2
28	Stendal silty clay loam.....	0-6 7-18 19-36	.10 .09 .05	5.9 5.0 4.9	72	1-2
31	Holly silt loam.....	0-6 7-18 19-36	.09 .08 .05	5.2 5.0 4.8	72	1-2
28D	Holly silt loam, dark-colored phase.....	0-6 7-18 19-40	.16 .14 .06	5.9 5.6 5.5	40	1-2
21	Pope loam.....	0-6 7-18 19-36	.08 .06 .04	5.5 5.3 5.0	72	1-2
11	Harbison silt loam.....	0-6 7-18 19-38	.22 .16 .07	4.8 4.6 4.6	(¹)	1-2
3	Tyler silty clay loam.....	0-6 7-18 19-36	.14 .06 .05	5.6 5.5 5.4	50	1-2
28W	Tyler silty clay loam, brown phase.....	0-6 7-18 19-36	.11 .08 .05	5.7 5.4 5.2	50	1-2

¹ Acid to bedrock.

TABLE 6.—*Nitrogen and acidity of Dubois County, Ind., soils—Continued*

Soil no.	Soil type	Depth	Nitrogen	pH	Average depth of acid soil	Indicated lime requirement per acre
		<i>Inches</i>	<i>Percent</i>		<i>Inches</i>	<i>Tons</i>
29	McGary silt loam.....	0-6 7-12 13-36	.10 .07 .05	5.6 5.4 7.3	30	1-2
15	Montgomery silty clay loam.....	0-6 7-10 11-34	.18 .17 .08	6.5 6.8 7.6	10	None.
54	Eel silty clay loam.....	0-6 7-18 19-36	.14 .12 .08	7.3 7.3 7.3	(2)	None.
47	Genesee silt loam.....	0-6 7-18 19-36	.14 .10 .06	7.5 7.7 7.7	(2)	None.
12	Genesee loam.....	0-6 7-18 19-36	.10 .09 .06	7.7 7.6 7.7	(2)	None.
37	Genesee fine sandy loam.....	0-6 7-18 19-36	.08 .06 .03	8.0 8.4 8.4	(2)	None.
M	Muck.....	0-6 7-20 21-40	1.71 1.26 .23	5.0 5.8 5.9	(3)	None.

‡ Not acid.

§ Slightly acid.

In interpreting the soil survey map and soil analyses, it should be borne in mind that a well-farmed, well-drained, well-fertilized, well-manured soil which is naturally low in fertility may produce larger crops than a poorly farmed soil naturally higher in fertility.

SOIL MANAGEMENT

For convenience in discussing the management of the several soils of the county, they have been arranged in groups according to certain important characteristics which indicate that in many respects similar treatment is required. For example, several of the silt loams of the uplands and terraces, which have practically the same requirements for their improvement, may be conveniently discussed as a group, thus avoiding the repetition that would be necessary if each were discussed separately. Where different treatments are required, they are specifically pointed out. The reader should study the group including the soils in which he is particularly interested.

SILT LOAM SOILS OF THE ROLLING UPLANDS AND TERRACES

This group includes the better drained silt loam soils of the uplands and terraces, which are those members of the Zanesville, Tilsit, Alford, Pike, Princeton, Haubstadt, and Bainbridge series that are not too rough or too sloping for cultivation. Zanesville silt loam is by far the most extensive soil of this group, occupying about 90,000 acres, or about 33 percent of the total area of the county, mostly in the eastern half and southwestern quarter. Zanesville silt loam, slope phase, ranks next with about 55,000 acres. The Bainbridge and Haubstadt silt loams occupy between 10,000 and 12,000 acres each, and the Alford, Tilsit, Pike, and Princeton soils are of minor importance.

Natural drainage of these soils ranges from fair to good, and they seldom suffer from a too wet condition, except on the flattest hilltops. All except the Haubstadt are subject to excessive surface run-off on account of too much slope. Concerning fertility, all these soils are acid and naturally deficient in phosphorus. There is also a more or less pronounced deficiency of nitrogen and organic matter. In most places where the land has been farmed for some time there is also need for more available potash.

DRAINAGE

The more level and the gently sloping areas of the soils in this group would be benefited by tile underdrainage, especially Tilsit silt loam which occupies the more level hilltops and rather flat areas in the vicinity of Zanesville. Where the land is sloping, plowing and other tillage operations should extend crosswise of the slopes, in order to lessen surface erosion by heavy rains. The prevention of erosion on the slopes is one of the major problems in the management of these soils, and the cropping systems and tillage operations must be planned and carried out with this in view. The surface soil contains the better part of the soil's store of fertility and should be protected against erosion by every practical means. If this cannot be done, the land should be taken out of cultivation before it is completely ruined. Some areas of Zanesville silt loam, slope phase, and other sloping areas that may be cultivated but are subject to erosion may be protected against erosion by judicious terracing.⁵

LIMING

All these soils are acid and are more or less in need of liming. The quantity of lime needed should be determined by soil-acidity tests in each case. If the farmer himself cannot make the test, he can have it made by the county agricultural agent or by the agricultural experiment station at La Fayette. A very acid soil will not respond properly to other needed treatments until it has been limed. Failure of clover to develop satisfactorily indicates a need of lime, although lack of thriftiness in clover may also be due to lack of available phosphorus or a bad physical condition of the soil owing to lack of organic matter. Ground limestone is the most economical form of lime to use in most places. As a rule, the first application should be at least 2 tons to the acre. After that a ton to the acre every second round of the crop rotation will keep the soil reasonably sweet. Where alfalfa or sweetclover is to be grown on an acid soil, heavier applications of lime may be needed.

ORGANIC MATTER AND NITROGEN

All the soils of this group are naturally low in organic matter and nitrogen. Constant cropping without adequate returns to the land and more or less soil erosion steadily make matters worse. In many places the original supplies of organic matter have become so reduced that the soil has lost much of its native mellowness and easily becomes puddled and baked. This condition in large measure

⁵ Information on terracing may be procured from the department of agricultural engineering, Purdue University Agricultural Experiment Station, La Fayette, Ind.

accounts for the more frequent clover failures and the greater difficulty in attaining proper tilth where the land has been cropped for a long time without adequate returns of organic matter. Wherever these evidences of lack of organic matter and nitrogen occur, the only practical remedy is to plow under more organic matter than is used in the processes of cropping. Decomposition is constantly going on and is necessary to maintain the productivity of the soil. Decomposing organic matter must also supply the greater part of the nitrogen required by crops. For this reason legumes should provide large amounts of the organic matter to be plowed under.

To obtain the legume growth, the land must be put in condition to grow clover and other legumes. This involves the application of lime or limestone wherever the soil is acid and also the application of soluble phosphates, because acid soils are invariably low in available phosphorus. After liming, from 200 to 300 pounds of superphosphate to the acre should be applied. Clover or other legumes should appear in the rotation every 2 or 3 years; as much manure as possible should be made from the produce that can be utilized for livestock; and all produce not fed, such as cornstalks, straw, and cover crops, should be returned to the land and plowed under. It must be remembered that legumes are the only crops that can add appreciable quantities of nitrogen to the soil, and then only in proportion to the quantities of top growth that are returned to the land, either directly or in the form of manure. Wherever clover-seed crops are harvested the threshed haulm should be returned to the land and plowed under.

Cover crops should be grown wherever possible to supply additional organic material for plowing under. Sowing soybeans, cowpeas, or sweetclover between the corn rows at the time of the last cultivation and seeding rye as a cover crop early in the fall on cornland that is to be plowed the following spring are good practices for increasing the supplies of both nitrogen and organic matter. It is important to have some kind of a growing crop on the soil during the winter to take up soluble nitrogen which otherwise would be lost through leaching. Without living crop roots to take up the nitrates from the soil water, large losses will occur between crop seasons through leaching. In this latitude the ground is not frozen much of the time during the winter, and frequent heavy rains cause much leaching, especially of nitrates, if not taken up by crops. The winter rains also cause much soil erosion on slopes and hillsides, if the ground is not well covered with vegetation. Both of these losses may be considerably lessened by a good cover of winter rye on all lands that otherwise would be bare during winter.

CROP ROTATION

With proper fertilization and liming, and tile drainage where needed, these soils will satisfactorily produce all the ordinary crops adapted to the locality. On account of the prevailing shortage of organic matter and nitrogen, every system of cropping should include clover or some other legume to be returned to the land in one form or another. Corn, wheat, and clover constitute the best short rotation for general use on these soils, especially when the corn can be cut and the ground can be disked and properly prepared for the wheat.

In this position in the rotation, wheat needs a high-analysis complete fertilizer, and the quantity applied should be sufficient to help the clover also. Corn, soybeans, wheat, and clover make an excellent 4-year rotation for these soils. The two legumes in the rotation will build up the nitrogen supply. The soybean straw should be spread on the wheatland in the winter. This will not only help the wheat and lessen winter injury, but it will help to insure a stand of clover. Oats are not well adapted to the climatic conditions of this section of the State and, as a rule, are not a profitable crop. The soybean is not only worth more as a crop but adds some nitrogen to the soil and improves the land for the crop that follows, which should generally be wheat. If more corn is wanted, as on livestock farms, the 5-year rotation of corn, corn, soybeans, wheat, and clover may be used satisfactorily where the second corn crop, at least, can be given a good dressing of manure. Where enough livestock is kept to utilize all the grain and roughage in this rotation, there should be enough manure produced to make a fair application for each corn crop.

A cover crop of rye for plowing under the following spring should be seeded in September on all the cornland. Where clover is uncertain in any of these rotations, because of climatic conditions, it has proved to be a good plan to sow a mixture of seed made up of about 4 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, and 1 pound of timothy to the acre. Lespedeza may be used to advantage in pasture mixtures and on thin spots in old pastures that need improvement, especially where the pasture land is acid and liming is not feasible.

Alfalfa and sweetclover may be grown on most of the soils of this group, if they are properly inoculated and sufficiently limed to meet the needs of these crops. Alfalfa is preferable for hay, and sweetclover is excellent for pasture and soil-improvement purposes.⁶

FERTILIZATION

All the soils of this group are naturally low in phosphorus, and in most places the available supplies of this element are so very low that the phosphorus required by crops should be wholly supplied in applications of manure and commercial fertilizer. The nitrogen supplies in these light-colored soils are also too low to satisfactorily meet the needs of corn, wheat, and other nonleguminous crops, and provision for adding nitrogen should be an important part of the program for improving these soils. The total quantities of potassium in these soils are large, but the available supplies are low, and in most places the addition of some potash fertilizer would be profitable, especially where little manure is applied. Without substantial provision for supplying all three of these fertilizer elements, the productivity of these soils is bound to decline.

The problem of supplying nitrogen has been discussed in connection with provisions for supplying organic matter. Legumes and manure are the logical and only really practical materials for supplying the greater part of the nitrogen needed by crops and should be largely employed for this purpose. A livestock system of farming with plenty of legumes in the crop rotation is, therefore, best

⁶ Special literature on the cultural requirements of these crops can be obtained from the Purdue University Agricultural Experiment Station at La Fayette.

for these soils. However, on most farms it will pay to have some nitrogen in the fertilizer for wheat, regardless of its place in the rotation. Even though wheat follows soybeans or other legumes, it should receive some fertilizer nitrogen at seeding time to properly start the crop, because the nitrogen in the residues of any immediately preceding legume does not become available quickly enough to be of much help to the wheat in the fall. The leguminous residue must first decay, and that does not take place to any considerable extent until the following spring.

Phosphorus is the mineral plant-nutrient element in which all these soils are most deficient, and soil erosion aggravates this deficiency. The only practical way to increase the supply is through the application of purchased phosphatic fertilizers. It will pay well to supply the entire phosphorus needs of crops in this way. In rotations of ordinary crops, producing reasonable yields, it may be considered that 20 pounds of available phosphoric acid to the acre are required each year. It is advisable to apply larger quantities at first, so as to create a little reserve. Enough for the entire rotation may be applied at one time or the application may be divided according to convenience. Where manure is applied, it may be counted that each ton supplies about 5 pounds of phosphoric acid, so that a correspondingly smaller quantity will be required in commercial fertilizer.

On the Francisco experiment field, located on Tilsit silt loam in Gibson County, highly profitable returns have been obtained wherever available phosphate has been applied on limed land, either with or without manure (pl. 1). During the 16 years since the experiments on this field were begun, acre applications of 300 pounds of 16-percent superphosphate for wheat, in a corn, wheat, and clover rotation, have produced crop increases averaging 3 bushels of corn, 6.8 bushels of wheat, and 490 pounds of hay to the acre. Manure applied at an average rate of 5.7 tons to the acre for corn has produced crop increases averaging 18 bushels of corn, 8.2 bushels of wheat, and 808 pounds of hay to the acre. However, manure alone does not furnish enough phosphorus for maximum yields. In addition to the manure used for the corn, 300 pounds to the acre of 16-percent superphosphate applied for wheat have produced additional crop increases of 5.1 bushels of corn, 6.3 bushels of wheat, and 585 pounds of hay to the acre. The results obtained on this experiment field apply very generally to Zanesville silt loam, with which Tilsit silt loam is associated.

The quantity of potash that should be supplied as fertilizer depends on the general condition of the soil and the quantity of manure used. In building up a run-down soil, a rather large quantity of potash fertilizer should be used, at least until such time as considerable quantities of manure can be applied or until the general condition of the soil has materially improved. There is plenty of potassium in these soils for all time if it could be made available at a faster rate, but as a rule it becomes available too slowly. Its availability may be materially increased by good farm practices, including proper tillage, tile drainage, the growing of deep-rooted legumes, and the plowing under of liberal quantities of organic matter. The better these practices are carried out and the larger



A, Effects of manure and lime on corn yields on Tilsit silt loam. Left, lime and manure, 55.7 bushels per acre; middle, manure, 48 bushels per acre; right, untreated, 31.4 bushels per acre. *B*, Effects of lime and phosphate on yields of hay on Tilsit silt loam. Left, untreated, 1,060 pounds per acre; middle, lime, 1,640 pounds per acre; right, lime and phosphate, 2,500 pounds per acre.

the quantity of manure applied, the less potash fertilizer will have to be purchased.

In the fertilization of these soils, most of the manure should be plowed under for the corn crop. When the crop rotation includes wheat, a part of the manure, possibly 2 tons to the acre, may be applied profitably on the wheat as a top dressing during the winter. Manure so used not only helps the wheat and lessens winter injury but also helps to insure a stand of clover or other crop seeded in the wheat. Unless very heavily manured, corn should also receive about 100 pounds of superphosphate to the acre in the row or hill at planting time. Without manure, corn should be given from 100 to 150 pounds to the acre of a phosphate and potash mixture, at least as good as 0-14-6,⁷ applied in the row or hill. Wheat should be given from 200 to 300 pounds to the acre of a high-analysis complete fertilizer, at least as good as 2-12-6. On poor soils or where the wheat is backward in the spring, a top dressing of about 100 pounds to the acre of a good soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing will usually produce from 5 to 7 bushels increase to the acre. Where properly fertilized corn and wheat are included in the rotation, there will be little need of fertilizer on other crops.

POORLY DRAINED SOILS OF THE UPLANDS AND TERRACES

This group includes the Johnsburg, Dubois, Robinson, Iva, Harbison, and McGary silt loams and Montgomery silty clay loam, which comprise a total area of about 12,000 acres, or 4.5 percent of the county. They occur mostly in the old lake bed in the north-western quarter.

DRAINAGE

All the soils of this group were developed under conditions of poor drainage, and, for the most part, they cannot be satisfactorily farmed without artificial drainage. Furthermore, no other beneficial soil treatment can be fully effective without some special provision for drainage. Most of the soils have been provided with some tile underdrainage, but where this has not been done, tiling should be a part of the soil-improvement program. Surface drainage should be regulated wherever possible, and rapid surface runoff should be prevented as much as possible because it carries away large quantities of available plant nutrients which should go into the production of crops. Rain water should be absorbed by the soil, and the surplus should pass away through underdrainage, as underdrainage increases the capacity of the soil to absorb water and lessens surface erosion. It also facilitates soil aeration which helps to make the plant nutrients in the soil available. A mottled subsoil is everywhere an indication of insufficient natural drainage.

Experience on experiment fields on other soils of similar texture and relief indicates that tile lines laid 30 inches deep and not more than 3 rods apart will give profitable results. Where the land is flat, great care must be exercised in tiling, in order to obtain an even grade and uniform fall. Grade lines should not be established by guess or any rule-of-thumb method. Nothing less accurate than a

⁷ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

surveyor's instrument should be used, and the lines should be accurately staked and graded before the ditches are dug, in order to make sure that all the water will flow to the outlet with no interruption or slackening of the current. The rate of fall may be increased toward the outlet, but it should never be decreased, as checking the current may cause the tile to become choked with silt. It is an excellent plan, before filling the ditches, to cover the tile to a depth of a few inches with a layer of straw, weeds, or grass. This prevents silt from washing into the tile at the joints while the ground is settling, thus insuring perfect operation of the drains from the beginning.

LIMING

The Johnsbury, Dubois, Robinson, Harbison, and Iva soils are all distinctly acid and in need of liming. The McGary soil is acid in the surface soil and subsurface soil, but it has an alkaline subsoil. The Montgomery soil is well enough supplied with lime. The quantity of lime required by the acid soils should be determined by soil-acidity tests, and recommendations for liming the silt loam soils of the rolling uplands and terraces apply equally well to these soils.

ORGANIC MATTER AND NITROGEN

The Harbison and Montgomery silty clay loams are naturally fairly well supplied with organic matter and nitrogen, and with reasonable care they can be maintained in good condition in this respect. The other soils of this group are similar to the silt loam soils of the rolling uplands and terraces in their organic-matter and nitrogen contents, and recommendations made concerning those soils apply equally well here, especially to the lighter colored soils. The cropping systems and the soil-management program should provide for the use of legumes, which supply both organic matter and nitrogen, as fully as possible, and all unused crop residues should be plowed under. Manure, of course, should be used to the fullest possible extent.

CROP ROTATION

This group of soils includes the best cornland in the uplands, and corn may well be the major crop in the rotation. However, by liming and proper drainage, the land should be put in condition to grow clover. Corn, wheat, and clover; corn, corn, wheat, and clover; and corn, corn, soybeans, wheat, and clover are all good rotations for these soils. The last-named rotation is especially to be recommended. In many rotations, instead of using clover alone for the hay crop, it has proved to be a good plan to sow a mixture of seed made up of about 4 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, and 1 pound of timothy to the acre.

FERTILIZATION

Except for the Harbison and Montgomery soils, which are naturally somewhat more fertile and do not need so much attention in this respect, and the light-colored flat soils with tight subsoils, which are generally lower in available potash than the soils of the rolling and better drained uplands, fertilization of these soils should be similar to that for the soils of the rolling uplands. In all cases,

however, wheat should be given a good complete fertilizer. Most of the manure should be put on the lighter colored soils, and some phosphate should be put in the row or hill for corn. Where manure is scarce, the corn should receive a half-and-half phosphate-potash mixture.

SANDY SOILS OF THE UPLANDS AND TERRACES

This group includes Elk very fine sandy loam and Princeton fine sandy loam. Although their total acreage in Dubois County is small, these soils are important on a few farms and need special attention. They are naturally deficient in organic matter, nitrogen, and phosphorus. Both soils are somewhat acid, but lime is not generally needed, except for such crops as alfalfa and sweetclover. In some places clover may also need some lime, and wherever clover fails to do well, the soil should be tested for acidity.

DRAINAGE

Drainage of these sandy lands ranges from good to excessive, and crops often suffer from lack of moisture. The only remedy is to increase the organic-matter content of the soil, so as to increase its water-holding power.

ORGANIC MATTER AND NITROGEN

Chemical analyses of these sandy soils show them to be poor in both organic matter and nitrogen. Some special provision, therefore, must be made for increasing both these constituents before the productiveness of the soil can be materially increased. As much manure as possible, as well as all unused crop residues, should be plowed under. Special green-manure crops and cover crops, such as soybeans, cowpeas, rye, and winter vetch, should be planted wherever possible for plowing under. Recommendations concerning this problem in the improvement of the silt loam soils of the uplands and terraces apply equally well here, and the practices recommended for those soils should be followed on these sandy soils. In fact, very sandy soils need larger supplies of both organic matter and nitrogen than do heavier soils, because they use up these constituents at a faster rate. Their loose, open, and in many places, excessively aerated condition favors rapid decomposition and oxidation, or the burning out of the soil organic matter. For this reason, more than ordinary quantities of organic materials, such as manure, crop residues, specially grown green-manure crops, and cover crops should be plowed under. The land should never be left without something growing on it.

CROP ROTATION

Of the extensively grown farm crops, these sandy soils are best adapted to small grains and legumes, especially alfalfa. Corn, as a rule, does well only on the lower areas and in places where the sandy surface soil is shallow and is underlain by heavier material. The higher and drier areas are better suited to such crops as melons, sweetpotatoes, early potatoes, and early tomatoes. They are also good for cowpeas, alfalfa, and sweetclover. Clover will not stand drought so well as alfalfa and sweetclover, and it should perhaps be replaced by these crops. Alfalfa can be as satisfactorily used in

short rotations as clover, after the land is once thoroughly inoculated for this crop.

FERTILIZATION

These sandy soils are naturally deficient in nitrogen and phosphorus. Chemical analyses show that the total supplies of phosphorus are so low that they should not be further drawn on. Stable manure should be applied as liberally as possible, both for its fertilizer constituents and for the organic matter it supplies. Manure, however, is seldom available in sufficient quantities, and commercial fertilizers high in phosphorus must be used. Legumes, in rotation or as special green-manure or cover crops, should be used to supply much of the needed nitrogen that is not provided in the form of manure.

Early potatoes, tomatoes, and other truck crops on these soils will respond to heavy applications of high-analysis complete fertilizers. An acre application of 500 or more pounds of at least a 2-12-6 mixture should be used. If wheat is grown, from 200 to 300 pounds to the acre of such a fertilizer is advisable. Where manure is not used, the fertilizer for truck crops should contain higher proportions of nitrogen and potash.

Where alfalfa or sweetclover is to be grown, 500 pounds to the acre of a high-grade phosphate-potash mixture should be applied at seeding time. A continuous stand of alfalfa should receive a top dressing of phosphate and potash fertilizer every 2 years.

SOILS OF THE WHITE RIVER BOTTOMS

The White River bottom lands consist of Genesee silt loam, Genesee loam, Genesee fine sandy loam, Eel silty clay loam, and Tyler silty clay loam. The Genesee soils include about 1,500 acres; and Tyler silty clay loam, brown phase, about 1,500 acres. Eel silty clay loam and the rest of the Tyler soil are for the most part too wet for cultivation. The greatest difficulty in the management of these bottom lands is to provide adequate drainage and to prevent damage from flooding. Tile underdrainage should be provided in the heavier soils, wherever suitable outlets can be provided.

Most areas of these bottoms that can be cultivated at all are well suited to corn, and this is the major and sometimes the only crop grown, but wherever drainage is satisfactory and flooding does not prohibit, some other crops should be included in the rotation from time to time, in order to provide a change from constant cropping with corn. In some places, wheat, clover, soybeans, Sudan grass, and sometimes sweetclover or alfalfa may be grown to advantage.

With the exception of Genesee fine sandy loam, these soils are fairly well supplied with organic matter, and, with reasonable care in their management, the nitrogen supplies can be satisfactorily maintained. On Genesee fine sandy loam, legumes should be grown wherever they can be fitted into the rotation. A cover crop to be plowed under should be seeded in the corn, and all crop residues should be conserved and worked into the soil.

Much of this land receives rich sediments from periodic overflows, and fertilizer is not so much needed as on the uplands. The poorer areas, however, will respond to applications of available phosphates,

and in some places potash also will prove profitable. If wheat is grown, it should receive a good complete fertilizer.

SOILS OF THE PATOKA RIVER AND CREEK BOTTOMS

This group of soils comprises the distinctly acid bottom lands consisting of deposits derived from the noncalcareous uplands, and it includes Waverly silt loam, Waverly silty clay loam, Stendal silty clay loam, Holly silt loam, Holly silt loam, dark-colored phase, and Pope loam. Holly silt loam occupies about 40,000 acres, or about two-thirds of the area of these bottoms and about 15 percent of the total area of the county. It is good cornland, though subject to overflow. Pope loam, which is next in extent in these bottoms, occupying about 13,000 acres, is better drained than the Holly soil. The other soils of the group are lower lying, and many areas have such poor drainage as to be too wet for cultivation.

Undoubtedly the greatest problem in the management of these soils is to provide adequate drainage and prevent damage from flooding. The heavier soils would be benefited by tile underdrainage wherever suitable outlets can be provided, in order that surplus water in the soil may drain away more readily when not held up by floods or high water in the streams. The precautions suggested in discussing the drainage of the poorly drained soils of the uplands and terraces should be observed in tiling these bottoms, in order to obtain satisfactory results.

LIMING

All the soils of this group are more or less acid, since they are derived from acid upland soils. Whether or not it will pay to apply lime depends on the crops the land is otherwise suited to and that are to be grown. Where the land is well drained and high enough to be free of damage from floods, liming may make it possible to grow clover and other deep-rooted legumes of high soil-improvement value.

ORGANIC MATTER AND NITROGEN

The recommendations made for supplying organic matter and nitrogen to the soils of the rolling uplands and terraces apply equally well to these bottom soils. On the lighter colored and poorer phases of these soils, especially, considerable organic matter should be plowed under, either directly or in the form of manure, and legumes should be grown wherever possible and largely returned to the land in one form or another, in order to increase the nitrogen content. Wherever the land is periodically flooded, clover and other deep-rooted legumes, especially biennials and perennials, cannot be depended on even if the land were limed. In such cases, certain shallow-rooted legumes, as soybeans, cowpeas, and sometimes alsike clover and lespedeza, can be satisfactorily grown and should be largely used to provide organic matter and for gathering nitrogen from the air, which they will do in large measure when properly inoculated. Here again it must be remembered that only the top growth plowed under, either directly or in the form of manure, will really increase the supply of nitrogen on which grain crops must depend. Cover crops, such as cowpeas, soybeans, or rye, in the cornfields, or sweet-clover where the land has been limed, should be used to the fullest

possible extent. Cornstalks should never be burned but should be cut up with a disk or stalk cutter and plowed under.

CROP ROTATION

In places where overflows cannot be prevented, the crop rotation must consist largely of annual spring-seeded crops and such grass and clover mixtures as will not be seriously injured by ordinary floods. For the most part, corn, soybeans, cowpeas, and in the higher areas oats or wheat, with a mixture of timothy and alsike clover following for a year or two, are satisfactory crops for this land. In many places, several crops of corn may be grown in succession, with proper fertilization, but some type of rotation is advisable to help maintain fertility. Doubtless the soybean will become more important as a rotation crop on these soils if proper inoculation is provided. A mixture of timothy and alsike clover will do well on this land after it has been limed, and this crop may be allowed to stand for 2 or 3 years. In places where the soil is too acid for alsike clover, lespedeza may be used. For late seeding in emergencies, early varieties of soybeans and Sudan grass, for either hay or seed, will prove useful.

FERTILIZATION

The deposits brought to these lands by overflow are not so rich as the deposits in the White River bottoms, and the soils therefore need more attention from the point of view of fertility. Where the land can be limed, most of the nitrogen required can be provided through the growth of legumes. Cowpeas and soybeans grow fairly well on acid soils, but liming will aid the development of the nitrogen-gathering bacteria. The frequent growth of legumes, especially on the lighter colored bottom-land soils, is very important, because these soils are naturally poor in nitrogen, and fertilizer nitrogen cannot be profitably employed to any considerable extent on corn and other low-priced crops on this land. Manure, of course, should be used wherever available. These bottom soils are all low in phosphorus, and most of this element needed by crops should be supplied in the form of commercial fertilizers. In most places, some potash fertilizer also will be profitable.

As a general rule, cereal small grains should receive from 200 to 300 pounds to the acre of 2-12-6 fertilizer. Corn should receive from 100 to 200 pounds of superphosphate or a phosphate and potash mixture placed beside the hill or drilled in the row when the seed is planted. Soybeans and cowpeas may also need some phosphate and potash fertilizer, although it is best to provide for these crops by heavier applications elsewhere in the rotation, because they are rather sensitive to injury to germination if the fertilizer is applied directly. Timothy meadows may be materially helped by top-dressing with a nitrogen fertilizer, after spring growth is well started.

NONAGRICULTURAL LANDS

A large part of the total area of the county is nonagricultural or, at least, nontillable. Such land is undesirable for ordinary farming and is of value only for forestry or pasture purposes. In the eastern half of the county, the nontillable lands constitute from one-half to three-fourths of the total acreage, including Muskingum

stony silt loam, Zanesville silt loam, eroded phase, and much of Zanesville silt loam, slope phase. In some places the slope phase of Zanesville silt loam is being successfully tilled, but in most places efforts at tillage have resulted in disastrous erosion and gullying.

Generally speaking, the only profitable use of these rough and very sloping lands is for the production of timber. Areas that have been cleared and found unfit for farming should be reforested with adapted trees and given protection from livestock.

SUMMARY

Dubois County lies south of the East Fork White River in southeastern Indiana. The relief ranges from undulating to hilly, but the larger part of the county is gently rolling, which gives rise to well drained and even excessively drained soils.

The principal markets are Evansville, Louisville, and Indianapolis, all of which are easily reached by either railroads or improved roads. The trunk automobile roads are constructed of crushed limestone and are fair, but the majority of the county roads are poor, frequently being impassable to automobiles during winter and spring.

The mean annual rainfall is 49.86 inches, and it is very well distributed. The climate is characterized by hot summers and mild winters.

Most of the soils are light colored and, where well drained and nearly level or undulating, are moderately fertile and adapted to general farming. The better agricultural soils are Bainbridge silt loam, Zanesville silt loam, Tilsit silt loam, Pike silt loam, Haubstadt silt loam, Alford silt loam, and Elk very fine sandy loam, which are well drained and favorably situated for crop production; Genesee silt loam, Genesee loam, and Genesee fine sandy loam, which are very fertile soils of the White River bottoms, but are inextensive; Holly silt loam which is somewhat less fertile and not so well drained as the Genesee soils and occurs in the first bottoms of Patoka River and the smaller streams; Princeton fine sandy loam and Princeton silt loam, which are well-drained fertile upland soils, with higher lime content than any other of the true upland soils but are very inextensive; and Harbison silt loam and Montgomery silty clay loam, which are dark-colored poorly drained soils, but which, when artificially drained, are fertile and are especially good corn soils. Dubois silt loam and Robinson silt loam are imperfectly drained moderately fertile soils of the lake plains; Johnsburg silt loam and Iva silt loam are poorly drained light-colored acid soils low in organic matter, which occur on the nearly level upland flats; and McGary silt loam is an imperfectly drained gray soil, of moderate fertility, somewhat higher in lime than the other light-gray soils, but of small total area. Minor soils of the bottom lands are Pope loam, Tyler silty clay loam, Eel silty clay loam, Stendal silty clay loam, Waverly silty clay loam, Waverly silt loam, and muck. The steeper lands of the eastern part of the county are mapped as Muskingum stony silt loam. This soil, and the eroded and slope phases of Zanesville silt loam are better adapted to forestry than to ordinary crop production.

Authority for printing soil survey reports in this form is carried in the Appropriation Act for the United States Department of Agriculture for the fiscal year ending June 30, 1933 (47 U. S. Stat., p. 612), as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Indiana, shown by shading. Detailed surveys shown by northeast-southwest hatching.

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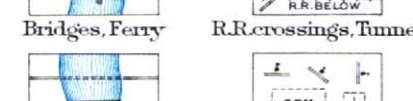
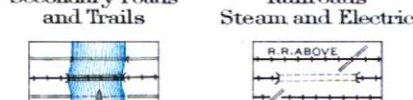
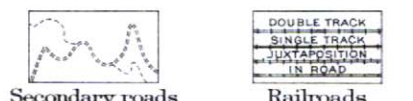
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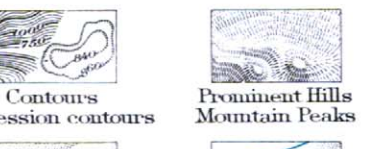
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The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

LEGEND

Alford silt loam Al	McGary silt loam Mc
Bainbridge silt loam Bn	Montgomery silty clay loam My
Bn Slope phase	Muskingum stony silt loam MI
Dubois silt loam DI	Pike silt loam Ps
Eel silty clay loam Ec	Pope loam Po
Meander phase Ec	Princeton fine sandy loam Pf
Elk very fine sandy loam Ev	Princeton silt loam PI
Genesee fine sandy loam Gf	Robinson silt loam Rs
Genesee loam Gm	Stendal silty clay loam Sy
Genesee silt loam Gs	Tiltsit silt loam Ts
Harbison silt loam Ha	Tyler silty clay loam Tr
Haubstadt silt loam Ht	Brown phase Tr
Holly silt loam H	Waverly silt loam WI
Dark-colored phase H	Waverly silty clay loam We
Iva silt loam Is	Zanesville silt loam Zs
Sandy phase Is	Eroded phase Zs
Johnsburg silt loam Js	Slope phase Zs
Muck Mu	

